Agro Technologies

2016-18

(Natural Resource Management & Crop Production,
Plant Protection and Farm Mechanisation)

Professor Jayashankar Telangana State Agricultural University

Rajendranagar, Hyderabad - 500030, Telangana State, India

PJTSAU

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FOREWORD

Dr.V. Praveen Rao

The Professor Jayashankar Telangana State Agricultural University, since its inception has been focusing on addressing the farm related problems through Science based approach leading to realization of higher productivity levels. The methodology adopted for development of farm technologies are thoroughly reviewed, fine tuned and improvised at various levels of consultations under the close monitoring of the University. This approach has resulted in identification and validation of technologies that are unique, distinct and consistent in performance across temporal and spatial parameters governing the agricultural ecosystems of the Telangana State. Emphasis is being given to develop technologies that are interdisciplinary, knowledge intensive, cost effective and exerting little pressure on ecosystem with an aim to achieve higher adoption rates in the farm holdings through appropriate extension outreach strategies.

Through a well thought out vision of the University, the crop improvement programmes are directed towards evolving genotypes that perform well with limited water usage and amenable for end to end mechanization in most important mandate crops. These products thrive on suitably customized agro techniques which augment their potential performance leading to higher remuneration to the farming community. This publication presents 81 such innovative farm technologies encompassing areas *viz.*, Natural Resource Management and Crop Production, Plant Protection and Farm Mechanization. These technologies are intended for adoption by the farming community in all the three Agro-climatic Zones of the State. I am confident that the technologies compiled in this publication are utilized by all the stake holders for practice on a large scale to realize the goal of enhancing the farmer's income.

On this occasion, I commend the wisdom, perseverance and efforts of all the Research Scientists involved in conceptualization and development of these Agro Technologies. All the technical personnel, University Officers involved in the compilation of this publication also deserve my wholehearted appreciation.

V. Praveen Rao

Date: 27-8-2018 (V. PRAVEEN RAO)

Place: Hyderabad

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PREFACE

Dr.R.Jagadeeshwar

Professor Jayashankar Telangana State Agricultural University caters to the location specific needs of the farming community by designing and developing cost effective farm technologies through multidisciplinary approach. The Research network of the University is operational through 15 Agricultural Research Experimentation Stations under Regional Agricultural Research Stations Head Quartered in three Agro climatic Zones of the State. Further, the Research efforts are undertaken by 27 AICRP schemes, two AINP centers and four GOI schemes in specified areas addressing the researchable issues at national level in general and State level in particular.

The process of development of Agro technologies is an interdisciplinary activity in continuum. The Research Wing of the University aims at evolving Technologies that are likely to have lesser impact on the environment as well as water and resource saving. These Technologies are subjected to continuous refinement through Extension machinery for improving the adoption pattern. The present publication "Agro Technologies (Natural Resource Management and Crop Production, Plant Protection and Farm Mechanization.)" is a compendium of technologies developed by all the research stations and schemes of PJTSAU. The approaches presented in this publication are aimed at reducing the farm investment by the farmer and also to enhance the Farmer income commensurate with policies of the Government. I place on record my sincere gratitude to Dr.V. Praveen Rao, Hon'ble Vice-Chancellor, PJTSAU for guidance, encouragement, support and valuable suggestions in bringing out this document in the present form.

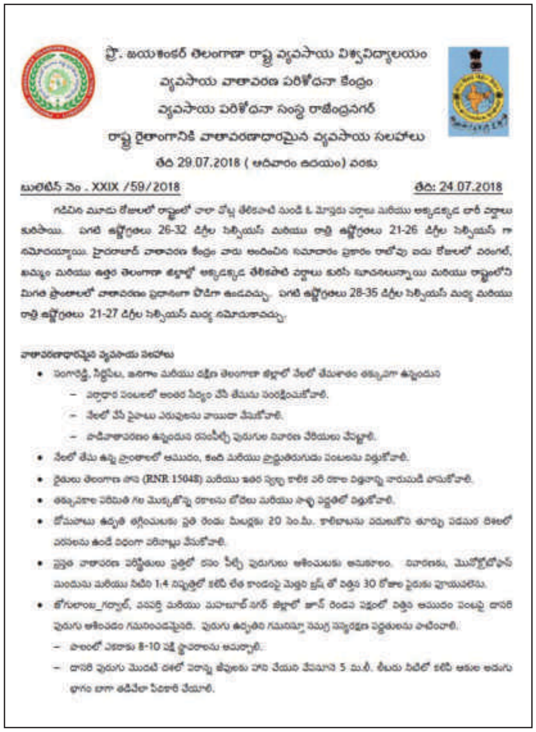
I complement the Associate Directors of Research of three agro climatic zones and the committed group of Research Scientists of PJTSAU associated with development of these technologies and for their precious and timely contributions which made this documentation possible. I also place on record my appreciation to the scientists who were directly or indirectly associated in bringing out this publication which will serve as guidance for all those involved in enhancing the Farm productivity.

(R.JAGADEESHWAR)

Date: 27.08.2018

Place: Hyderabad

Agromet Advisory Services to Address Weather Variability



ప్రొ. జయశంకర్ తెలంగాణ రాష్ట్ర వ్యవసాయ విశ్వవిద్యాలయం
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రాష్ట్ర రైతాంగానికి వాతావరణాధారమైన వ్యవసాయ సలహాలు
తేది 29.07.2018 (ఆదివారం ఉదయం) వరకు

బులెటిన్ నెం . XXIX /59/2018 తేది: 24.07.2018

వాతావరణాధారమైన వ్యవసాయ సలహాలు

Weather based agro-advisories

Salient Features

Weather conditions play a significant role in reaping a good agricultural harvest. Timely weather information enables the farmers to plan their farm operations in a way that not only minimizes the costs and crop losses in the event of bad weather but also helps in maximizing the crop yields under good weather conditions.

Weather forecasts are useful tools for making decision regarding choice of crop, variety, planting and harvesting time and investments in farm inputs such as irrigation, fertilizer, pesticides, herbicides etc. Improved weather forecast through Agromet advisory services greatly help the farmers in taking the advantage of benevolent weather and mitigate the impacts of malevolent weather conditions.

In Telangana, the Agromet advisories are prepared based on medium range weather forecast of IMD considering the past and forecast weather, soil type, crop phenophases etc., and disseminated twice in a week (every Tuesday and Friday). The Agromet advisories are being disseminated through print (local newspapers) and electronic media (Websites: www.imdagrimet.gov.in, Mobile App: Kisan Suvidha, Doordarshan, All India Radio, SMS: www.mkisan.gov.in).

The weather forecasts and advisories have been helping the farming community to take advantage of prevailing weather conditions. On many occasions farmers who followed Agromet advisories saved the crop from unfavorable weather conditions like drought, flash floods, cold, hail storms and heat waves etc., and minimized the crop loss.

Impact and Benefit

The assessment of impact of Agromet advisory services in improving the farm income in Rangareddy district over a period of three years indicated that increased net returns due to weather based agro advisories were to the tune of 10.66 to 30.50 % in different crops and the benefit accrued was Rs. 3229 to Rs.8270/ha.

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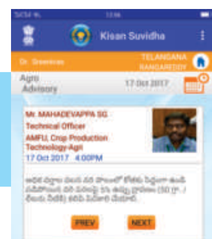
Dissemination of agro-advisories through Kisan Suvidha app



Sowing Rule to Adjust to Climate Variability in Rainfed Area

Salient Features

Sowing rule helps farmers to combine their traditional knowledge and experience with results from scientific research and modeling studies in dealing with climate variability. Farmers traditionally go for early sowing with onset or the first showers of monsoon. Such early sowing is a gamble as the subsequent rainfall events are highly unpredictable. Many times re-sowing is commonly practiced after the failure of seedling emergence. The cost of seed, labour and other inputs have increased considerably and their availability in time is often a constraint. A cumulative rainfall of 50 to 75 mm is required to ensure seedling survival even if a moderate dry spell follows immediately after sowing.

Performance

Simulations model test runs on the sowing rule over the period showed that the sowing of rainfed crops with cumulative rainfall of 50-60 mm in light soils, and 60-75 mm in heavy soils are effective to prevent seedling failures. By considering carefully long term data and current weather conditions, sowing rule advisory is made on the correct time to start sowing in rainfed areas to reduce the risk of failure of sowing in farmers fields.

Cost of Technology

No additional cost.

Impact and Benefit

The rainfall based sowing rule has the field advantage as it is simple to understand, to apply and can be more objectively estimated at the village level provided there is a rain gauge and a person available to record and display the rainfall data.

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Use of Planting Windows to Produce Quality Hybrid Seed

Seed production plot of DHM 117

Seed production plot of CSH 16

Salient Features

In India, various agro-climatic conditions prevail and it is very difficult to identify the correct planting time to synchronize flowering in male and female parents of hybrids to produce seeds of field crops.

Performance

Maize: Sowing of parental lines of hybrid DHM 117 (BML-6&7 in second fortnight of June in *Kharif* and first fortnight of October in *Rabi* is optimum to synchronize flowering of parents to achieve higher hybrid seed yield and get high percentage of quality hybrid seeds.

Jowar: Early sowing of parental lines of CSH 16 in the first week of October will synchronize flowering of parents to produce higher hybrid seed yield with good quality.

Cost of Technology

No additional cost.

Impact and Benefit

The information generated can be used to produce higher seed yields in hybrids of maize (DHM 117) and sorghum (CSH 16) without additional cost.

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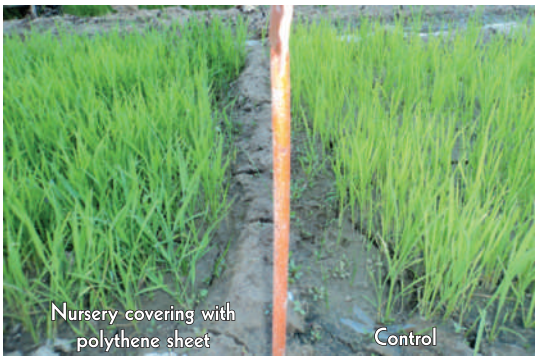
Management Practices for Cold Injury in *Rabi* Rice Nurseries

Cold injury in rice nurseries



Salient Features

Cold injury has been identified as one of the major abiotic constraints limiting the yield potential of *rabi* rice. In Telangana, rice nurseries during *rabi* are raised from second fortnight of November to the end of December. The nurseries sown in December experience low temperature (daily minimum temperature of 8-10^{0}C) which severely restricts seedling growth and sometimes leads to the death of seedlings. The common effects of cold injury during nursery include low germination, slow growth of seedlings, leaf yellowing, stunted growth characterized by reduced height. Consequently, more time is required for seedlings to attain four leaf stages for transplantation compared to normal wet season.

Performance

Application of double the recommended rate of P_2O_5 (5 kg P_2O_5 for 500 m^2 nursery area sufficient for 1 ha main field) and covering nursery beds with polythene sheet or locally available and low cost fertilizer bags at 45 cm above the ground level during night and removing in the morning, irrigating nursery bed every day in the evening and letting out water in the morning resulted in highest root length, shoot length and seedling height at 15 and 30 days after sowing.

Cost of Technology

The cost for purchasing of polythene sheet is Rs.1200/ha and operational cost in addition to normal nursery rising is Rs. 1800/ha.

Impact and Benefit

Covering nursery bed with polythene sheet reduces the time required for seedling to attain four leaf stage for transplantation than that required in nursery without protection.

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Early Sowing with High Yielding Variety to Improve Seed yield and Oil Content in Rainfed Safflower

Safflower grown under different dates of sowing

Salient Features

To obtain the maximum yield in safflower, it is necessary for development stages of plant to escape from unfavourable environmental effects of temperature and day length, and make full utilization of favourable environmental conditions. Hence, sowing date can be selected to enable plants to grow vigorously. An early sowing with improved varieties *viz.*, Annigeri-1/NARI-57 *i.e.*, by 15th October is desirable for safflower sown as a rainfed crop to mitigate terminal drought stress and to realise consequent higher seed and oil yield. A suitable combination of genotype and sowing date is more important to obtain higher economic yield.

Performance

Early sowing Var. Annigeri-1 on 15th October recorded the highest seed yield (1673 kg/ha) and oil yield (395 kg/ha). However, oil content was maximum when NARI-57 was sown on that date (27.96%).

Cost of Technology

This technology involves partial modification of sowing time along with use of a superior high yielding variety. Hence, cost of cultivation for implementing this technology is similar to that of the conventional time of sowing *i.e.*, last week of October and beyond (Rs. 16,340/ha).

Impact and Benefit

Timely sowing is the key non-monetary input in safflower for obtaining higher yield. Early sowing allows the cool season crop like safflower to utilize fully favourable environmental conditions like lower temperatures and shorter day lengths which help in better growth and oil biosynthesis. Sowing high yielding variety like Annigeri-1 as early as by 15th October is recommended for obtaining higher seed and oil yields and enhanced returns.

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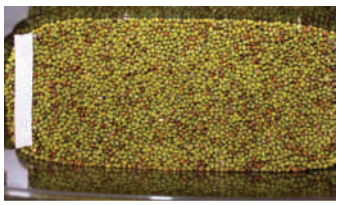
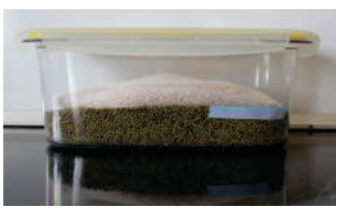
Use of Desiccant Beads for Seed Storage





Seeds stored in air tight container with silica gel

Salient Features

High quality seeds of improved varieties are essential to enhance production of crops. In tropical climates, high temperature and humidity cause rapid deterioration of seed in open storage, resulting in loss of value, poor stand establishment, lower productivity and act as disincentive to invest in improved seed. Most seeds in the targeted locations are locally produced or self-saved and are stored without proper drying. Maintaining the seed at required moisture status would greatly extend their storage life.

Performance

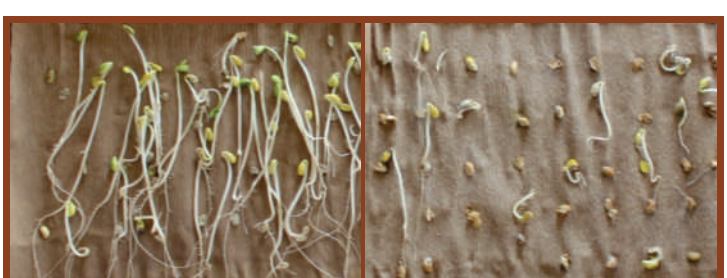
Rice and sunflower seed stored in air tight container along with reusable zeolite drying beads made of sodium alumino silicate @ 0.35 kg per kg seed followed by seeds stored in air tight container with silica gel maintained higher germination, seed viability and seed health. The zeolite beads help to reduce humidity drastically in the containers with seed.

Cost of Technology

Cost of Drying beads is Rs.350 per kg of seed, and these zeolite drying beads are reusable for 400 to 500 times.

Impact and Benefit

The unique properties of the zeolite beads make it easy to achieve 3 to 6% moisture content or ultra dry conditions during storage of seeds. The technology is completely scalable from individual farmers to large seed companies of low volume/high value crops and is applicable where maintaining seed quality is difficult due to high temperature and humidity.



Germinability of seed under desiccant bead storage & normal conditions

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Bud Chip Technology in Sugarcane

Budchip

Seedlings raised from budchips

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Salient Features

Sugarcane is commercially planted using setts at the rate of 6-8 tonnes/ha which is around 10% of total produce. Bud chip technology involves separating the buds alone from cane and planting seedlings raised from buds in a nursery using small plastic cups or trays. After chipping away buds, canes can be sold to derive income. This technology is economically viable as compared to traditional method of planting using two to three budded setts.

Performance

In this technique, nursery is raised using single bud, and 30 days old seedlings growing from buds are transplanted in the field at a wider spacing of 45 cm within the row to facilitate availability of abundant solar radiation and soil aeration that enhances levels of tillering. Results showed that using bud chips for crop establishment resulted in saving of seed material, germination time, high yields, higher net returns.

Cost of Technology

Normally farmers invest Rs.30,000/ha in planting setts. With the adoption of bud-chip nursery technology costing 19,875/ha, an amount Rs.10,125/ha is saved.

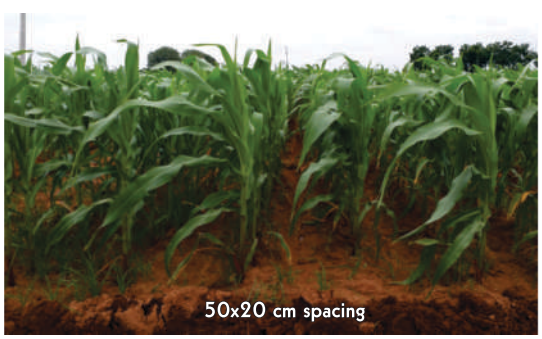
Impact and Benefit

Treatment of bud chips (with 0.1% 2 Chloro ethyl phosphonic acid + 0.2% $CaCl_2$) improves bud sprouting, rooting, plant vigor and tillering of bud chip raised seedlings under field conditions. It is a time, labour, and input saving method to get high yields.

Crop at formative stage

Importance of Planting Density in Maize

60x20 cm spacing



50x20 cm spacing

Salient Features

Plant density exerts a significant effect on maize yields by influencing plant architecture, vegetative and reproductive growth that determine the degree of competition between plants.

Performance

The optimum plant density for corn or pop corn is 83,333 plants/ha (at a spacing of 60 x 20 cm); and baby corn it is 1,11,111 plants/ha (45 x 20 cm). At these optimum plant densities, maize productivity is increased by 7.3% in grain and by 8.7% in pop corn. Similarly, maize productivity increased by 25.4% in baby corn hybrids at optimum plant densities.

Impact and Benefit

Increasing productivity through agronomic management is one of the important strategies which could be achieved when it is grown at optimum plant spacing with adequate plant density. This technology offers a cost benefit of Rs.1600/ha due to increased yield from plants.

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High Density Planting System in Cotton for Rainfed Ecosystem

High density planting system of cotton

Salient Features

High density planting system (HDP) with spacing of 45 cm between rows and 15 cm between plants is a new initiative to improve the productivity of rainfed cotton on marginal shallow to medium deep soils. Closer canopy cover in high density planting system gives reasonably higher yields even if plants bear less number of bolls; additional cost of cultivation is low in close planting.

Performance

High density planting system of 45 x 10 cm spacing gave high seed cotton yields of 2,818 kg/ha in the variety Suraj and 1833 kg/ha in WGCV-48. The incidence of sucking pests and natural enemies with different plant populations remained at the same levels. In rain shadow areas of Warangal district, adopting HDP with a marginal additional investment helped farmers reap good yields (12.5-32.5q/ha) in cotton.

Cost of Technology

Cost is Rs. 45,000/ha.

Impact and Benefit

HDP of cotton is a low input technology amenable for mechanization. The yield levels are comparable with farmers practice with low cost of cultivation.

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A Novel Technique to Increase Productivity of Redgram by Transplanting

Sowing of Seeds

Transplanting in main field

Salient Features

Transplanting technique in redgram provides ample scope to increase yields and profits to farmers. Medium duration redgram varieties which reach flowering stage with the onset of winter season are suitable for transplanting. Raising the nursery in advance by mid-May and transplanting 30 to 35 day old seedlings is the best method to enhance yield.

HDPE polyethene bags of 4" x 6"(10 x 15 cm) are filled with soil without any fertilizer in which 2-3 seeds, pre-treated with Rhizobium culture (@ 50 g/kg seeds) are sown. These bags with seeds should be essentially kept in partial shade. Seedlings (30 to 35 days old) are transplanted at a spacing of 180 x 90 cm in deep black soils(2469 plants/acre) and at 150 x 60 cm in light soils (4445 plants/acre). Furrows are opened in the main field and are fully irrigated just before transplanting. Seedlings along with mud balls are transplanted on one side of the furrow and regular recommended package of practices can be adopted.

Performance

Transplanting technique increased the productivity to 3435 kg/ha *i.e.*, 685 kg/ha more over the productivity of conventional system considering that the average productivity in farmers field was 2750 kg/ha.

Cost of Technology

On an average, cost of transplanted redgram technology ranges from. Rs.28,000 to Rs. 32,000 per ha which is Rs. 15,000 higher over conventional method of sowing redgram.

Impact and Benefit

With an additional investment (Rs.15000/ha), extra redgram production of 685 kg/ha is achieved which gives more profit to farmers. Raising nursery reduces both the duration period required in the main field and the cultivation cost. In Telangana state, redgram is sown in an area of 2.2 lakh ha to produce 1.09 lakh tonnes. Even if 25% redgram area is brought under this technology, it can easily add 1.24 lakh tonnes and increase the total production to 2.33 lakh tonnes of redgram.

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Square Planting in Redgram

Square marking

Square Planting in Redgram

Salient Features

Square planting is a new approach to increase the redgram yields in rainfed areas. Redgram possessing plasticity for growth habit and responds to the crop plant geometry to a greater extent. Low rainfall condition, coupled with higher plant population is the single most important constraint affecting the yields due to more evapo-transpiration (ET) demand subjecting the crop to terminal drought stress.

In square planting technique marking of the field is done at 100 x 100 cm in black soils and at 75 cm X 75 cm in red soils using the bullock or tractor drawn marker. Two to three seeds are sown at each intersection point. At 20 days after sowing (DAS), thinning is done leaving a single healthy plant at each intersection point. All other recommended package of practices are adopted.

Performance

Square planting technique increased the productivity by four-folds (2000 kg/ha) as compared to that of average productivity from conventional system in the state (500 kg/ha).

Cost of Technology

On an average, cost of square planting in redgram is Rs. 15,000/ha which is almost equal to that of conventional method of sowing.

Impact and Benefit

The square planting is most viable and practicable method under rainfed conditions of Telangana state which can help in increasing the productivity by 160%. This technology can be recommended to all the agro-climatic zones of the state.

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Suitable Sugarcane Varieties for Planting at Wider Spacing

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Salient Features

Sugarcane varieties Co86032, 85R186, 97R401 are suitable for cultivation in wider spacing to obtain higher cane and sugar yields. Growth and yield response of these varieties planted at a wider spacing of 150 cm between rows and 60 cm within rows, using 2-single budded setts (@ 1 ton /ha) was superior in contrast to traditional planting with spacing of 90 cm between rows with three budded setts (@ 4 tons /ha) placed end to end overlapping within the row.

Performance

Among the four varieties tested Co 86032 recorded higher number of millable canes (76 t/ha) followed by 97R401 (68t/ha).Other yield parameters *viz.*, cane length, cane girth and single cane weight were superior in 97R401 and hence higher cane yield of 152 t/ha was recorded. Varieties 85R186 & Co 86032 recorded on par cane yields of 123 t/ha & 118 t/ha respectively. Higher sugar yield of 16 t/ha was recorded in Co 86032 followed by 85R186 (15t/ha) & 97401(14 t/ha).

Impact and Benefit

Varieties Co 86032, Co 85R186, 97R401 are suitable for cultivation at wider spacing to get higher cane and sugar yields. Further, planting single budded setts at 60 cm intra-row spacing has enhanced yield. Seed requirement can be reduced to three fourth of normal, due to usage of two single budded setts per each hill, thus reducing the overall cost of cultivation. Wider row planting also facilitates mechanization and gives a possibility to raise suitable intercrops to get additional income to the farmers.

Two-Row Sugarcane Planting on Widely Spaced Furrows for Mechanized and Drip Irrigated Cultivation

Layout of two rows of seed (2 budded setts) in single furrow

Crop at formative stage

Salient Features

After introduction of drip irrigation, farmers are cultivating sugarcane at a wider spacing of 150 or 180 cm resulting in production of less millable canes/ha due to reduced plant stand per unit area. High density planting in 2-rows within a furrow to maintain higher plant stand per unit area will produce more millable canes/ha. Dense planting of sugarcane within a row with proper nourishment has a scope to realize high yields.

Performance

Ridges and furrows are formed at a spacing of 210 cm in the field. Seed material is planted in paired rows (2-rows) 30 cm apart in every single furrow. This method of planting is more beneficial in achieving high cane (145 t/ha) and sugar (27 t/ha) yields under mechanized and wide spacing systems of ridges and furrows in sugarcane field. Adopting this paired row planting method registerd high gross (Rs.374816/ha) and net (Rs.251936/ha) returns and higher returns to farmers (BC ratio Rs.2.05/ha).

Cost of Technology

Total cost of cultivation with paired row technique is Rs.1,22,880/ha.

Impact and Benefit

Planting of sugarcane in 2-rows in each furrow can improve productivity through accommodating more propagating material under intense farming conditions compared to wider spaced single row planting in furrows.

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Alternate Wet and Dry (AWD) Management in Rice

Field water tube | Installed field water tube

Measuring water level in field water tube

Salient Features

Creating alternate wet and dry (AWD) conditions in rice fields is a water-saving technology suitable for farmers and can be used to reduce water input. AWD irrigation water management is best suited for adoption in tank-fed and canal command areas. A practical way to implement AWD is to monitor the depth of impounded water on the field using a 'field water tube.' A plastic (PVC) tube of 40 cm length, 6 mm thick and 15 cm in diameter is used. The lower half of tube (20 cm) is perforated with holes at 5 cm spacing on all sides. One end of the tube with perforations is inserted gently into the soil so that at least 20 cm length of tube protrudes above the soil surface. Tube is placed in a flat part of the field close to a bund for easy monitoring.

Performance

Implementation of AWD : AWD can be started a few days after transplanting. After irrigation, the depth of impounded water gradually decreases and when this water level drops to 15 cm below the surface of the soil, field is re-flooded with 5 cm of water. In the initial stages (transplanting to panicle initiation) the water level can safely recede to 10 cm below the surface of the soil. But, during flowering stage, the field should be irrigated when the water level falls to 5 cm below the ground. After flowering, during grain filling and ripening, the field is re-flooded only when water level drops to 15 cm below the ground surface.

Cost of Technology

The cost is Rs.1000 for procurement and installation of field water tube.

Impact and Benefit

The technology can be profitably adopted in canal commands and tank fed areas. Irrigation water is saved to the extent of 20 to 30% without any reduction in yield. The water so saved can be used for area expansion under irrigation or provide an assured supply to the tail-end fields. This AWD improves soil health and is environment friendly as it reduces methane emission. Further it saves a part of expenses on labour and energy used in the normal practice of continuous irrigation.

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Farm Pond Technology for Rainfed Crops

Farm Pond

Maize crop grown under life saving irrigation through farm pond technology

Salient Features

Crop growth and yield are severely affected due to erratic, unpredictable and inadequate rainfall resulting in crop failures in rainfed areas. Farm pond technology is a viable option to harvest and store run-off rain water and irrigate the crops during dry spells especially at critical crop growth stages. This technology is best suited for the regions which receive a seasonal rainfall between 500 and 750 mm. Adoption of micro-irrigation (sprinkler and drip irrigation) methods for life saving irrigation further improves the crop productivity and water use efficiency.

Performance

Two life-saving irrigations with harvested water collected in farm ponds enhances crop growth and productivity by 50-75% in drought sensitive maize crop and 35% in pearl millet and ragi compared to growing these crops under rainfed situation.

Cost of Technology

The cost to dig and lay with polythene sheet (500 micron thickness) in 10 m x 10 m x 2.5 m farm pond is about Rs. 45000.

Impact and Benefit

The technology can prevent water scarcity even if dry spells are encountered during mid or terminal crop growth stages and also assure a minimum returns to the farmers. Harvested water can also be used to raise nursery or timely spraying of plant protection chemicals in rainfed areas.

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Soil Moisture Conservation Techniques in Cotton

Ridge and furrow

Cotton crop sown in ridge and furrow method

Salient Features

Ridge and furrow and broad bed furrow land configuration techniques were developed for moisture conservation in rainfed cotton. The broad bed and furrows are formed by BBF maker at one meter width and are followed by a 50 cm wide furrow of about 15cm depth. The ridges and furrows are made with bund former.

Performance

The moisture level in soils with these practices remained at 12-14%, compared to 9.2% in flat bed sowing. Seed cotton yield in flat beds using moisture conservation techniques was 1155 kg/ha, 30% more over farmers' practice (885kg/ha).

Cost of Technology

The adoption of ridge and furrow, and broad bed furrow technology additionally costs Rs. 4500/ha.

Impact and Benefit

The land configuration is a good agronomic practice for soil moisture conservation as well as for drainage in case of excess rainfall so as to minimize crop losses. The conservation techniques gave an extra monetary benefit of Rs.10000/ha.

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Drip Irrigation Regimes and Fertigation Schedules in *Rabi* Sorghum

Sorghum crop under different drip irrigation regimes and fertigation schedules

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Salient Features

Sorghum is one among the few resilient crops that can adapt well to future climate change conditions, particularly with respect to increase in severity of drought, soil salinity and high temperature conditions. The sorghum is cultivated in 4.3 M ha during *rabi* season in India. The global challenge for coming decades is to increase the food production with utilization of less water. It can be particularly achieved by increasing crop Water Use Efficiency (WUE). Sorghum seed production is taken up under irrigation during rabi in Northern Telangana areas. This technology was proposed to increase the water productivity and yield of sorghum with less water.

Performance

Irrigation at 1.0 Etc throughout crop growth or irrigation at 0.8 Etc up to flowering and either 1.0 or 1.2 Etc later on recorded higher mean grain yield (6210 kg /ha) and net returns (Rs. 66,700) and BC ratio (2.59) in *rabi* sorghum. Fertigation with 100% RD N and K (100-60-40 kg/ha) at weekly intervals (ten splits) gave higher water productivity (2.120 kg/ha-mm) and net returns (Rs. 66095).

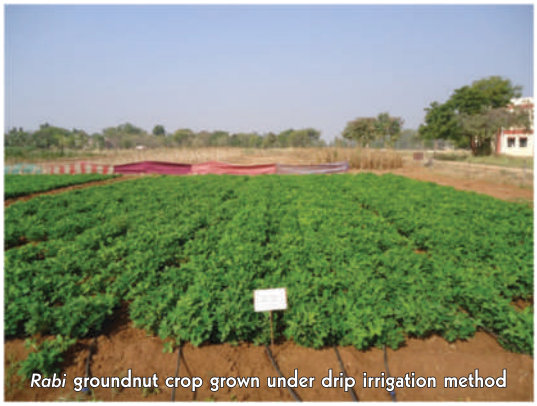
Cost of Technology

Installation of drip system costs around Rs.100000 to Rs.125000/ha. Due to high initial investment government is providing 80-100% subsidy to farmers.

Impact and Benefit

- Nutrients are supplied in precise way. Nutrient use efficiency is increased. Fertilizer use efficiency is twice than that of conventional method of fertilizer application.
- Nutrient losses through leaching, evaporation, immobilization are minimized in fertigation.
- Cost of cultivation is minimized in terms of saving on fertilizer and pesticides usage and reduction on labour force.
- Ecological balance is maintained in fertigation practice.
- Increase in crop yield and improvement in product quality is achieved through fertigation.
- 107.7% increase in yield and 29% saving in water over surface (furrow) irrigation method.

Yield Enhancement and Water Saving through Micro-Irrigation in *Rabi* Groundnut



Rabi groundnut crop grown under drip irrigation method

Salient Features

In Telangana state, groundnut is grown in 1.2 lakh ha of which 89% (1.07 lakh ha) is grown during *rabi* season. Most of the farmers irrigate the crop by using overhead sprinklers and a few farmers by flood irrigation. Adoption of micro-irrigation either through drip or raingun was found to be promising in groundnut.

Performance

Scheduling of irrigation (0.8 Epan) and fertigation through drip method (100% recommended dose of N and K) and soil application of 100% recommended P resulted in 8.2, 8.9 and 9.8% higher dry pod yield of groundnut over sprinkler (1.0 Epan), raingun (1.0 Epan) and check basin (1.0 Epan) methods of irrigation. Further, water use efficiency was higher through drip irrigation(6.54 kg/ha-mm) as compared to that of check basin (4.91 kg/ha-mm), sprinkler (4.74 kg/ ha-mm) and raingun (4.70 kg/ha-mm) methods. Drip irrigation method saved 110 mm water and reduced labour requirement by 50% over traditional method.

Cost of Technology

The cost and installation of drip system is around Rs. 1.25 lakhs/ha.

The cost of overhead sprinklers and raingun ranges from Rs. 20,000 to 25,000 per set.

In view of high initial investment, government is providing 50-90% subsidy.

Impact and Benefit

Drip irrigation helps to save 110 mm water besides increasing yield by 10% as compared to other methods of irrigation.

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Integrated Nutrient Supply for Rice-Rice Sequence Cropping

Performance of Rice under 50% N substitution with *Gliricidia*

Salient Features

The integrated supply of nutrients by substituting 25 or 50% N fertilizer to rice with organic green manure in *kharif* season and applying 100% recommended dose of fertilizer during *rabi* is an ideal technology in rice-rice cropping system.

Performance

Gliricidia is a hardy leguminous tree species that can be raised with stem cuttings on field boundaries at a spacing of 2m x 2m and yields about 10 t/ha of fresh biomass per annum. Incorporation of *Gliricidia* loppings as green leaf manure @ 8 t/ha to substitutes 50% N requirement of rice in *kharif* and recommended dose of fertilizer (120-60-40 kg NPK/ha) application during *rabi* sustained 2-crop system yield at 11 t/ ha.

On system basis, annually 25% of fertilizer cost (equivalent to 60-30-20 kg NPK) is saved with integrated treatments using *Gliricidia* grown on field bunds, but achieving a similar productivity levels to that of application of RDF (120-60-40 kg NPK/ha).

In case of less availability of biomass, *Gliricidia* substitution @ 25% N was also equally effective in sustaining the productivity of 10 t/ha.

Cost of Technology

Use of *Gliricidia* as green leaf manure to substitute 25 or 50% N requirement of rice in *kharif* reduces the cost of cultivation marginally by Rs.200-300/ha with higher additional net returns of nearly Rs.2000-3000/ha due to yield improvement compared to application of sole chemical fertilizers.

Impact and Benefit

The integrated supply of nutrients by substituting 25 or 50 percent N fertilizer to rice with green manuring in *kharif* season is an adoptable technology in rice–rice cropping system. For higher productivity and sustenance of soil fertility in terms of higher organic carbon, available macro and micro nutrients application of organic manures in combination with fertilizers is quite profitable to farmers.

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Balanced Fertilization for Sustainable Soil and Crop Productivity in Rice-Rice Cropping Sequence

Rice crop grown under different NPK combinations

Salient Features

In cereal based cropping systems, the soil available reserves of carbon and NPK are shoveled heavily. A deficit of about 10 M t of NPK is estimated against the requirement of 30 M t every year. Subsidized availability coupled with instant response of N fertilizers prompted indiscriminate N and P applications to cereals, particularly more exclusive application of DAP has resulted in nutrient imbalance. Decrease in factor productivity or response ratio to 6 kg is another alarming situation. Despite continuous mining, secondary and micro nutrients are seldom replenished. In post green revolution era multiple nutrient deficiencies including micro nutrients is one of the important problems making systems unsustainable. In view of these facts, a participatory research was carried out in farmer's fields to quantify the productivity potential of rice-rice cropping systems with a set of nutrient combinations treatments for continuous four years.

Performance

Productivity of rice-rice system was higher (11.41 t/ha) with recommended dose of NPK (120-60-40 kg/ha) than with farmers (11.10 t/ha) practice (148-85-20 kg/ha). Further, higher status of organic carbon and available N, P, K were observed with application of recommended dose of NPK over farmers practice.

Cost of Technology

Recommended dose of NPK saved Rs. 1500/ha and recorded additional net returns of Rs.10630/ha than farmers practice.

Impact and Benefit

Balanced application with recommended dose of NPK resulted in higher grain yield, net returns and preserved the soil fertility over a period.

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Phosphorous Requirement and its Time of Application in Rice Grown on P Accumulated Soil

Salient Features

The continuous use of P through complex fertilizers is expected to result in its accumulation in top layers of soil due to high fixation and low use efficiency by crops. Use of this accumulated P can be an option to decrease the input cost of P fertilizer in crop production.

The rice growing farmers in many regions apply P fertilizer in split doses through complex fertilizers because they perceive that plants require P throughout the crop growth period like nitrogen. However, according to many researche studies, application of P at the time of transplanting is a recommended practice for paddy. Moreover, farmers do not pay much attention to time of phosphorus fertilizers application resulting in low phosphorus use efficiency.

Performance

The yield level that could be achievable with 100 % recommended dose of P (60 kg P_2O_5/ha) to P accumulated soil can be obtained with a lower dose of 75 % RDP (45 kg P_2O_5/ha) to the same crop and thus saving 15 kg of P input without sacrificing the yield of rice crop grown on P accumulated soils. Hence, the application of 75 % RDP is recommended for rice grown in P accumulated soil under Nizamabad condition.

With respect to time of P application, two equal splits of P at basal and at early tillering stage (14-20 days after transplanting) as top dressing recorded highest grain yield (6.69 t/ha) which was on par with complete P as basal application (6.62 t/ha). In general, application of P at the time of transplanting is a recommended practice for paddy. However, due to various reasons it is not always possible to apply the entire P at the time of transplanting. Under such circumstances, it is appropriate to go for two equal splits at basal and top dressing at early tillering stage (14-20 DAT) in P accumulated soils.

Cost of Technology

A net saving of P fertilizers from current recommended dose by 15 kg P_2O_5/ha (25 % of RDP) and saving of cost of P fertilizers applied per hectare to the extent of Rs. 750.

Impact and Benefit

Reduced application of P helps to reduce cost of cultivation to the farmer.

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P-Fertilizer Saving in High P Soils for Maize and Rice

Salient Features

In Telangana districts more than 78% of soils are at high phosphorus status. There is a need to utilize this build up and unavailable forms of P by making them available to reduce the cost of cultivation and to maintain balanced level of nutrient availability in soil. Crops differ in their capacity to utilize the native phosphorus when raised on high-P soils (> 59 kg P_2O_5/ha). Thus, it is important to identify crops that are efficient users of native accumulated P as well as applied P.

Performance

When maize is grown in soils with high P levels, 50 to 75% of recommended dose of phosphorus can be saved without reducing the yield of crop. In rice, 25 to 75% of P fertilizer input cost can be saved if soil test P value confirms the high P levels.

Cost of Technology

Application of P fertilizer can be reduced or saved by 75% if soil test P value is more than 100 kg P_2O_5/ha, by 50% if soil test P value ranges from 70-85 kg P_2O_5/ha and no saving of P fertilizer if soil test P value is below 65 kg P_2O_5/ha. Cost of fertilizers varies depending upon the amount of P fertilizers used for the maize and rice crops. On an average, cost of saving on P fertilizers varies between Rs.445 and Rs.1560/acre (Rs.600 and Rs.2300/ha in terms of DAP) depending on available P status in soil.

Impact and Benefit

Application of P fertilizers based on soil test value reduces the input cost on P fertilizer without any reduction in yield but improves the P use efficiency of applied fertilizer to provide a balanced nutrition to the crop.

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Cost Reduction on Zinc Fertilizer by Increasing Its Use Efficiency

Salient Features

The use efficiency of applied zinc fertilizer in crops is less (from 3 to 5%). Incubating 10 kg of zinc sulphate (i.e. half of the recommended dose of 20 kg/acre) with 200 kg of well decomposed farm yard manure (FYM) for a month with intermittent mixing and moistening helps to increase zinc use efficiency by more than 100% when compared to that of zinc sulphate application alone @ 20 kg/acre.

Performance

Application of 10 kg of zinc sulphate incubated for 30 days with FYM to field before sowing or transplanting the crop enhanced the yield of paddy and chilli that was same as that obtained with only zinc sulphate @ 20 kg/acre. This technique helps lower the expenditure on zinc fertiliser by 50% without affecting yield but by enhancing its use efficiency.

Cost of Technology

Generally, small quantities of FYM or well decomposed organic manures are available with the farming community or can be prepared by farmer from the field residues. There is no additional expenditure on adoption of this technique

Impact and Benefit

Reduced application of zinc sulphate helps to reduce the subsidy burden to the Government on zinc fertiliser which further aids the government to cover more farming area with the same budget allocation. Application of 10 kg zinc sulphate incubated mixture with 200 kg FYM to crop per acre of zinc deficient soil increases its use efficiency and reduces cost incurred by Rs. 400/acre without affecting yield of crops.

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Site Specific Nutrient Management in Maize

Effect of nutrient management on maize hybrids

Salient Features

Site specific nutrient management (SSNM) approach advocates a dynamic management of nutrients to optimize supply and demand of a nutrient from plants within a specific field in a particular cropping season. It takes into account soil fertility status, crop needs, and previous crop history to derive the nutrition requirement of the crop. Adoption of SSNM in exhaustive crops such as maize results in higher productivity at a reduced cost of cultivation. It also prevents nutrient over-mining and its depletion from soil.

Performance

SSNM dose of 190-84-143 kg NPK/ha recorded a maize grain yield (8749 kg/ha), equal to yield obtained with recommended dose of fertilizer (200-60-50 kg NPK/ha), and farmers practice (253-58-75 kg NPK/ha). Hence, farmers can adopt this SSNM fertilizer application in maize crop to reduce cost without any reduction in yield.

Impact and Benefit

Adopting the technology of SSNM of fertilizers in maize is easy to practice and reduces the cost of inputs by Rs.1250/ha. Additionally, for one rupee investment the net benefit is Rs. 2.71.

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Fortification of Fodder Maize with Zinc

Salient Features

Fodder maize is most ideal and versatile fodder crop owing to its animal preference. It is suitable for cultivation in all seasons, and consumption in all use patterns and at all stages of crop growth. Fodder maize is gaining wide acceptance among dairying community. Fodder maize can be fortified by soil application of 50 kg zinc through $ZnSO_4$.

This application significantly increased the quality of maize fodder by increasing the zinc concentration (23% higher zinc concentration over control). Foliar sprays of $ZnSO_4$ @ 0.2 g/l at critical stages viz., knee high and tasselling stages along with soil application of 10 kg $ZnSO_4$/acre also gave on par green fodder yields. However, accumulation of zinc in tissue (fortification) was higher when applied @ 20 kg/acre to soil than soil application of 10 kg/acre along with two foliar sprays at knee high and tasseling stages.

Performance

Soil application of $ZnSO_4$ @ 20 kg/acre as basal during the last ploughing produced highest green fodder yield (21.2 t/acre) and showed a tissue concentration of Zn (42 mg/kg). The zinc accumulation in tissues (fortification) with this treatment was 23% more when compared to no zinc control. Foliar sprays of $ZnSO_4$ @ 0.2 g/l at critical stages viz., knee high and tasselling stages along with soil application of 10 kg $ZnSO_4$/acre produced 19.6 t /acre (1.6 tonnes less than soil application of 20 kg $ZnSO_4$/acre) of green fodder yield.

Fodder quality in terms of crude protein (CP) and fibre though were not influenced by application of $ZnSO_4$ @ 20 kg/ acre while the concentration on Zinc in tissue increased by 23 percent compared to that of control (no zinc application).

Cost of Technology

Cost of soil application of $ZnSO_4$ @ 20 kg/acre is Rs.1060/ acre.

Impact and Benefit

Zinc application enhances the quality of fodder besides, the yield. There is an increase of 346 kg of green fodder yield per kg of zinc sulphate applied to soil.

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Economizing Phosphorus Use in Groundnut through P- Solubilizing Bacteria

Salient Features

Application of complex fertilizers usually lead to P-fixation particularly in the top layers of soil and is thus made unavailable to plants. The main constraint in groundnut production is inability to utilize this unavailable P reserves in soils. The native P is effectively utilized by application of P solubilizers like DGRC1 (Directorate of Groundnut Research Culture-1) and DGRC 2 (Directorate of Groundnut Research Culture-2).

1 kg seed is inoculated with 200g culture as well as 5% jaggery solution to reduce the cost on P fertilizers and increase the pod yield.

Performance

Application of 100% P (16 kg P_2O_5 /ha), FYM@ 5 t/ha and seed treated either with DGRC 1 (1351 kg/ha) or with DGRC 2 @ 200g/kg of seed (1291 kg/ha) recorded highest groundnut pod yield than control (811 kg/ha) and it was comparable with 50% P (8 Kg P_2O_5 /ha), FYM@ 5 t/ha and seed treated either with DGRC 1 (1125 kg/ha) or DGRC 2 (1129 kg/ha).

Maximum benefit cost ratio 3.83 and 3.75 was obtained with 50% P (8 Kg P_2O_5 /ha), FYM@ 5 t/ha and seed treated either with DGRC 1 or DGRC 2, respectively.

Cost of Technology

Rs. 5700/ha.

Impact and Benefit

Bio fertilizers and FYM are supplemental nutrient sources whic bring the unavailable forms into available forms and also promote the growth of root exudates.

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Rescheduling of Fertilizer Doses for Soybean in Northern Telangana

Salient Features

Revision of recommended fertilizer doses for different crops is essential with the changed soil fertility status, micronutrient deficiencies, build-up of some nutrients like phosphorus and change of cropping pattern or introduction of new varieties etc. In fact, this revision is overdue and is a long pending need.

Performance

With adoption revised fertilizer dose (125% N, 100% P, 100% K, 125% Zn, 25% S, 25% B) 16 % higher yield (2339 kg/ha) was reported in seed yield of soybean. The seed yield of soybean varied from 1968 to 2339 q/ha. The net returns and benefit cost ratio also increased with revised fertilizer dose (Rs. 50,051/ha and 1.43, respectively).

Taking into consideration the seed yield and economics, application of 125% N; 100% P; 100% K; 25% Zn; 25% S; 25% B (80-60-40-5-5-2.5 kg N-P_2O_5-K_2O-Zn-S-B/ha) can be recommended for soybean grown in Vertisols of Northern Telangana Zone.

Cost of Technology

The increase in net returns with this recommendation over current RDF is to the extent of Rs. 9689/ha.

Impact and Benefit

Application of 125% N, 100% P, 100% K, 125% Zn, 25% S, 25% B recorded 18% yield increase over current recommendations.

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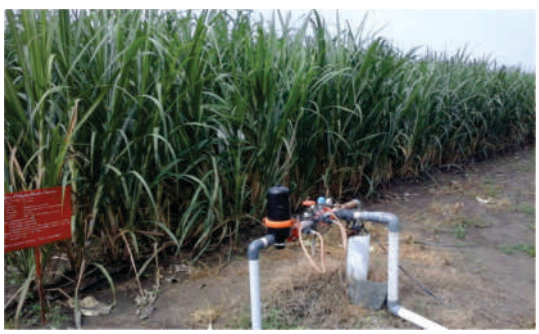
Fertigation Schedule in Sugarcane



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Salient Features

The conventional irrigation and fertilizer application methods in sugarcane lead to considerable loss of water and leaching of nutrients resulting in low productivity. Fertigation is a modern technique for application of both water and fertilizer through irrigation and has been proved to be very effective in achieving higher yield and water use efficiency when these crucial inputs are delivered precisely in the effective crop root zone as per the crop needs and crop developmental phases.

Performance

Drip fertigation @ 125% recommended dose of fertilizers (312.5-125-150 kg $N\text{-}P_2O_5\text{-}K_2O$/ha) at weekly intervals produced maximum cane yield (165.6 t/ha) over conventional surface irrigation with soil application of fertilizers (134.3 t/ha). The drip irrigation used less quantity of water (1236 mm) and saved 20% water over surface irrigation method. The highest water productivity (13.6 kg/m^3) recorded with 125% RDF was 40% higher over conventional surface irrigation with soil application of fertilizers.

Drip fertigation with 125 % RDF through water soluble fertilizers applied in 17 equal splits at weekly intervals starting from 45 DAP to 180 DAP was found suitable for productive sugarcane cultivation in Vertisols of Northern Telangana.

Cost of Technology

The higher net returns of Rs.79,584 and Rs.78,851 were obtained with plant and ratoon crop, respectively using drip fertigation @125% RDF over surface irrigation with soil application of fertilisers. The additional cost of cultivation with drip fertigation @125% RDF over surface irrigation with soil application of fertilisers is to the extent of Rs. 5966/ha for plant crop and Rs.6322/ha for ratoon crop (excluding drip installation costs).

Impact and Benefit

Drip fertigation with 125% RDF (312.5-125-150 kg $N\text{-}P_2O_5\text{-}K_2O$/ha) showed 26% increase in cane yield of plant crop, 47% yield increase of ratoon crop over conventional surface irrigation with soil application of fertilizers.

Rescheduling of Fertilizer Dosage for Sugarcane in Northern Telangana

Salient Features

Revision of fertilizer doses for different crops is essential with the changed soil fertility status, micronutrient deficiencies, build-up of some nutrients like phosphorus and change of cropping pattern or introduction of new varieties etc. In fact, this revision is overdue and is a long pending need.

Performance

The highest pooled average cane yields (133.8 t/ha) were obtained with application of 125% N, 100% P, 100% K, 125% Zn, 25% S, 25% B and 5t FYM/ha. Revised RDF recorded higher cane yield (20.5 % higher compared to existing RDF), higher net returns and improved soil fertility over the years. Taking into consideration the yield and economic sustainability, application of revised dose of fertilizers (312.5-100-120-25-10-2.5 kg N-P_2O_5-K_2O-Zn-S-B/ha) in conjunction with 5 t FYM/ha can be recommended for sugarcane grown in Vertisols of Northern Telangana Zone.

Cost of Technology

The increase in net returns to the farmer by adoption of this recommendation over current RDF is to the extent of Rs. 79,449. The additional cost of fertilizers applied with this rescheduling is Rs. 8,490/ha.

Impact and Benefit

Application of integrated use of optimal fertilizer dose with manure was successful in sustaining the high level of cane yield and in the improvement of soil fertility. Further, the inclusion of Zn, S, and B in fertilizer schedule will aid in preventing micro-nutrient deficiencies in soils under continuous cropping of sugarcane.

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Soil Test Based Prescription Equations for Balanced Fertilizer Use and Targeted Yield of *Rabi* Castor in Light Soils

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Salient Features

Indiscriminate use of chemical fertilizers without any addition of organic manures has almost rendered the soil unfit for further cultivation and posed serious problems to soil health. Soil test based fertilizer use, particularly through pre-calibrated prescription equations were developed for *rabi* castor.

Performance

Soil test based fertilizer prescription equations for targeted yield (25 or 30q/ha) of *rabi* castor were developed in light soils for major nutrients with chemical fertilizers and by including vermicompost.

Only with chemical fertilizers	With Chemical fertilizers + Vermicompost @ 5t/ha
FN= 15.54 T – 2.30 SN	FN= 15.54 T – 2.30 SN – 0.04 VC N
FP= 4.72 T – 6.44 SP	FP= 4.72 T – 6.44 SP – 0.60 VC P
FK= 4.75 T – 0.44 SK	FK= 4.75 T – 0.44 SK – 0.45 VC K

T = Target in q/ha; FN, FP and FK = Fertilizer N, Fertilizer P_2O_5 and Fertilizer K_2O, respectively; SN, SP and SK = soil test values for N, P and K/ha

When soil test values obtained were 125 kg N, 15 kg P and 150 kg K/ha, by using above equation, application of 101 kg nitrogen, 21 kg P_2O_5 and 31 kgK_2O/ha is estimated as needed to attain target yield of 25q/ha with chemical fertilizers; and 96 kg nitrogen, 20kg phosphorus and 24 kg potassium are needed along with 5t/ha vermicompost to attain this target yield in *rabi* castor. The deviation in fertilizer use by employing soil test based prescription equations in comparison with that of general RDF (80-40-30 kg NPK/ha) was (+) 21 kg N, (-) 19 kg Phosphorus and (+) 1 kg Potassium in Alfisols (Light soils) for the above fertility status of the soil.

Cost of Technology

Generally, the cost of soil testing in government soil testing labs is nominal and is in the range of Rs 10 to 20 per sample (farmer field). The said technology can be implemented with this simple soil testing and interpretation of results.

Impact and Benefit

Application of balanced fertilizers improves soil health, prevents indiscriminate use of chemical fertilizers and helps in best input use efficiency. These fertilizer prescription targeted yield equations can be recommended to the light soils (Alfisols) of Southern Telangana Zone of the state to attain the target yield of 25 or 30q/ha in *rabi* castor.

Efficacy of Herbicides in Direct Seeded Rice

Cyhalofop-butyl + (Chlorimuron ethyl + metsulfuron methyl) sprayed plot

Unweeded Control

Salient Features

Grasses, sedges and broad leaved weeds in aerobic rice have been reported to cause 30-70% yield loss. As weed infestation competes with rice for water and nutrients, growth of rice is adversely affected and crop productivity is reduced significantly. Farmers are increasingly resorting to herbicide use to control weeds due to ever increasing cost of labour and their non-availability when required.

In direct seeded rice, post-emergence application of cyhalofop-p-butyl (100 g/ha) and a combination herbicide (chlorimuron ethyl 10% with metsulfuron methyl 10% 4.0 g/ha) or Fenoxaprop P ethyl 9% at 60 g/ha and a combination herbicide (chlorimuron ethyl 10% with metsulfuron methyl 10% 4.0 g /ha) effectively controls a broad spectrum of weeds that results in higher grain yield comparable to two hand weedings at 25 and 50 days after sowing (DAS).

Performance

Adoption of this technology resulted in 1200-1400 kg /ha yield advantage compared to the farmers practice of 2-hand weedings at 25 and 50 DAS. The overall net returns with the adoption of herbicides in rice is Rs.16000-20000/ha.

Cost of Technology

Rs. 2200 /ha (Fenoxaprop P ethyl 9% 60 g/ha and (chlorimuron ethyl 10% + metsulfuron methyl 10% 4.0 g /ha). Rs. 3500 /ha (Cyhalofop-p-butyl (100 g/ha) and (chlorimuron ethyl 10% + metsulfuron methyl 10% 4.0 g/ha)

Impact and Benefit

Combination of herbicides with broad spectrum action provides superior weed control compared to lone application of either pre or post emergence herbicides with narrow spectrum weed control. This new technology lowers the weed competition from the beginning and reduces loss of nutrients to rice crop. The saving in weeding cost is Rs. 10000 -12000/ha compared to hand weeding.

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New Post-Emergence Herbicides for Weed Management in Maize

Maize crop in Untreated control

Maize crop in herbicide treated plots

Salient Features

Weed management in maize crop grown in heavy soils during rainy season has become a serious problem due to continuous moisture in the soil of field crops and also labour shortage during the peak period of agricultural operations and as a result yields are reduced drastically. To overcome this, a post-emergence herbicide Tembotrione (Laudis) 34.4% SC @ 115 ml/acre) or Topramezone 33.6% SC (Tynzer) 30 ml/acre can be used at 2-4 leaf stage of weeds to effectively control grasses and broad leaf weeds.

Performance

Grassy and broad-leaf weeds in maize cause 30-50% yield loss. Continuous uses of selective herbicide such as atrazine for both pre- and post-emergence weed management may result in development of resistant biotypes of weeds besides changes in weed flora.

New molecules like tembotrione or topramezone offer a better weed control of weeds and avoid shift in the grass or broad leaf weed flora. Tembotrione as post-emergence recorded 31.4% higher yield compared to atrazine as pre-emergence application. This resulted in an increase of Rs.20,000/ha in net returns in maize. Topramezone application resulted in a 28.2% yield increase over pre-emergence application of atrazine alone.

Cost of Technology

Rs.4,000-4200/ha.

Impact and Benefit

These herbicides have potential for post-emergence control of graminaceous weed in maize, which is not possible with other selective herbicides. Further, chemical weed management saves time and labour for weeding, avoids loss of nutrients and reduces cost of weeding. Due to timely management of weeds in maize the yields have increased by 28-32%.

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Chemical Weed Management in Greengram

Imazethapyr PE fb Quizolofop ethyl POE treated plot

Untreated plot

Salient Features

Effective control of broad spectrum of weeds at critical stages is essential through application of different combination of herbicides. The efficiency of chlorimuron ethyl at 3.5 and 2.5 g a.i./ha and imazethapyr at 70 g a.i./ha as pre-emergence application and quizolofop ethyl @ 50 g a.i./ha as post emergence application were tested to control late emerging grassy weeds in greengram.

Performance

It was found that chlorimuron ethyl applied as pre-emergence resulted in effective control of weeds but showed toxic effect on crop. Use of imazethapyr @ 70 g a.i./ha as pre-emergence and quizolofop ethyl @ 50 g a.i./ha as post-emergence herbicides showed positive results in weed control along with better yields in *kharif* greengram.

Pre-emergence application of imazethapyr @ 70 g a.i./ha controlled most of the broad leaved weeds and grassy weeds were controlled effectively by quizolofop ethyl @ 50 g a.i./ha applied as post-emergence herbicide which in turn resulted in lower weed dry matter production, higher yield attributes and grain yield in greengram. Higher net returns of Rs.57574/ha were realised as compared to unweeded control (Rs.19801/ha) and every rupee invested gave two rupees at harvest in greengram during *Kharif* season.

Cost of Technology

Rs. 3128/ha (Cost saving of Rs.2497/ha as compared with farmers practice).

Impact and Benefit

Chemical weed management saves time and labour for weeding and reduces cost on weeding. Combination of weedicides resulted in broad spectrum of weed control at critical stages of green gram which in turn resulted in higher yield and monetary benefits.

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Ideal Management Practices for *Rabi* Castor

Rabi castor under Conventional method

Rabi castor under drip fertigation

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Salient Features

Rabi castor offers yield advantage of 40-52% (23-25 q/ha) over *kharif* castor (15 q/ha)as production during *kharif* season is seriously affected by *Botryotinia* gray mold and drought. This yield advantage can be realized when *rabi* castor is grown under drip fertigation compared to conventional irrigation and fertilizer application.

Performance

Cultivars: PCH-111, PCH-222, DCH-177, DCH-519 and any other hybrid

Sowing time: October first fortnight is optimum for higher yields (23 q/ha)

Spacing: 120 x 60 cm under drip irrigation compared to 90 x 60 cm under normal cultivation

Irrigation

Drip irrigation: Three days interval @ 0.9 Pan Evaporation (Epan) to get high yields (35 q/ha). Total quantity of water required is 400-450 mm.

Conventional method: 5 cm at 50 mm cumulative pan evaporation (CPE) for high yields (20 q/ha). A total of 10-12 irrigations (500-600 mm) are required at an interval of 12-15 days between October and December, and later at 8 days interval. Flowering and capsule development are critical stages.

Fertilizer dose: Under drip irrigation: 120-40-30 kg NPK/ha with P and K as basal. Fertigation of N at 6-day interval.

Fertigation schedule: 30 kg N from 10 DAS to 55 DAS, 50 kg N from 56 DAS to 85 DAS, 20 kg N from 86-115 DAS, 20 kg N from 116 to 145 DAS for achieving higher seed yield (35 q/ha)

Under conventional irrigation: 80-40-30 kg NPK/ha with P and K as basal; one-half dose of N as basal and rest in three equal splits at 30, 60 and 90 days after sowing (DAS).

Cost of Technology

The cost is Rs. 38,000/ha for drip irrigation and Rs. 30,000/ha for conventional irrigation

Impact and Benefit

This technology can double the yields and net income. Improvement in yield is 40-52% through drip fertigation besides 30% water saving.

Best Management Practices for Yield Maximization in Rainfed Safflower

Laying of Broad Bed and Furrow

Safflower grown under best management practices

Salient Features

Safflower, *Carthamus tinctorius* L. is an edible oil seed crop grown in Vertisols during *rabi* season under receding soil moisture conditions. Though, safflower is known as a low input crop, it responds positively under best management practices.

The best management practices are adoption of optimum time of planting (the first fortnight of October), high yielding safflower cultures (Hybrid DSH-185 or varieties TSF-1/A-1/PBNS-12), Broad Bed and Furrow (BBF) method of planting, seed treatment with *Azospirillum* and phosphate solubilizing bacteria (PSB) @ 20 g each per kg of seed, adoption of optimum plant spacing (45 x 20 cm), one hand weeding at 30 DAS to reduce crop–weed competition, application of RDF (40-20-0 kg NP and K /ha) as basal and need based plant protection measures to control aphids.

Performance

The productivity of safflower under the best management practices was 2091 kg/ha. An enhancement of 52.8% in yield over conventional cultivation was realised (1369 kg/ha) and higher net returns were recorded (Rs. 43247) as compared to farmers practice (Rs. 35574). Adoption of BBF system improved the levels of available soil moisture (25-24%) at 0 to 15 cm; and (12-29%) at 15 to 30 cm depth between 35 and 75 days after sowing.

Cost of Technology

An amount of Rs.18,450/ha is required to implement the technology which is Rs.2110/ha additional over farmers practice.

Impact and Benefit

The technology is implementable both under rainfed and irrigated conditions with equal ease. Adoption of the best management practices improves the safflower seed yield by 52.8% over farmers practice. The Broad Bed and Furrow (BBF) planting system aids in efficient soil moisture conservation and thus, supports crop through mid-season or late-season dryspells.

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Efficient Cropping Systems for Southern Telangana

Maize based cropping systems

Salient Features

Crop diversification in irrigated-dry cropping systems is very essential especially in Southern Telangana. Eight cropping systems *viz.*, maize-groundnut, maize-sunflower, maize-castor, maize-wheat, soybean-maize, soybean-wheat, soybean-sunflower, and soybean-castor were evaluated for five years to identify resource efficient cropping systems.

Performance

Maize based cropping systems performed better than soybean based systems. The system productivity, in terms of mean maize equivalent yields over 5-years was high with maize-groundnut (10.34), maize-sunflower (9.94) and maize-castor (9.90) systems. Among the soybean based systems in terms of productivity, soybean-maize (9.05) was superior over other systems. Per day productivity and per day returns was superior with soybean-maize. The soil organic carbon content and available nutrient status after 5-cropping seasons was close to the initial status.

Cost of Technology

Maize followed by groundnut or sunflower or castor is more remunerative cropping system for this region. Maize-castor system recorded higher system net returns (Rs.74,406/ha) with a benefit cost ratio (Rs.2.56) and lower cost of production (Rs.29,840/ha) than all other systems. The next best systems in terms of profitability (net returns and benefit cost ratio) were maize-sunflower (Rs.72,986/ha; B:C Rs.2.14) and maize-groundnut (72,157/ha; B;C Rs.2.45). Among the soybean based systems tested soybean-maize was more remunerative with higher net returns (Rs.64215/ha; B:C Rs.2.10).

Impact and Benefit

Increased income to the farmer and insurance against crop failure.

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Diversification of Rice-Rice Cropping Systems in Southern Telangana

Alternate crops to *rabi* rice in STZ

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Salient Features

Diversification of rice-rice with irrigated-dry (ID) crops is needed in the water scarce Southern Telangana. Rice-maize is the most dependable cropping system with increased productivity and profitability per hectare. It also saves considerable quantity of water. In the areas where existing agro–ecological situation permits two ID crops, more economical and profitable systems like maize-castor or maize-groundnut may be adopted instead of rice-rice.

Performance

In continuous rice growing areas, *rabi* rice can be diversified with maize. Rice-maize recorded higher mean system productivity of 7285 kg/ha and net returns (Rs.35045/ha; Rs.1.29/rupee) over rice-rice (5760 kg/ha; Rs.14790/ha; Rs.0.47/rupee). In the areas where existing agro-ecological situation permits, more productive, economical and profitable systems such as maize-castor (8915 kg/ha; Rs.46740/ha; Rs.2.23/rupee), maize-groundnut (7510 kg/ha Rs.35504/ha; Rs.1.39 rupee) may be adopted instead of rice-rice (5760 kg/ha; Rs.14790/ha; Rs.0.47 rupee). The vegetable crops like tomato, green chillies, onion may be grown in rabi season following maize for higher returns in peri-urban areas, as marketing facilities are readily available.

Cost of Technology

The option of cultivation of maize as *rabi* or *kharif* crop instead of rice saves Rs.5000/ha. Maize-castor require a less expense (Rs.21,000/ha) than that of rice-rice (Rs.30,000/ha) and rice-maize (Rs.27,000/ha) cropping systems. However, cultivation of vegetable crops like onion, tomato or green chillies is more expensive than rice but gives higher net returns that make them more profitable to farmers.

Impact and Benefit

Maize-castor, maize-groundnut and rice-maize are superior to rice-rice cropping system in terms of production use efficiency and water use efficiency. The farmer can choose any of the systems: rice-maize, maize-groundnut, maize-castor or maize followed by vegetables like tomato or onion or green chillies to suit local requirements and to diversify the existing rice-rice cropping system.

Bio-intensive Complimentary Cropping Systems for Southern Telangana

Bt cotton and greengram (1:2) followed by maize for green cobs system

Salient Features

Maize, *Bt*-cotton and rice are predominant crops in southern Telangana. All these crops are being grown as sole crops and are non-leguminous in nature. Introduction of complementary crops/cropping systems is needed for sustainable production under water scarce conditions of the region. Inclusion of legume crops with appropriate agronomic interventions either in sequence or intercropping might be a more viable and economical option. The best cropping systems aim to produce more grain yield as well as palatable/nutritious fodder to livestock economically.

Performance

Bt cotton and green gram (1:2) - maize for green cobs system recorded the highest productivity (13.16 t maize equivalent yield/ha) over maize-groundnut system (11.21 t MEY/ha). The system was found to exhaust higher quantities of nitrogen (182.7 kg/ha), phosphorous (27.2 kg/ha) and potassium (130.4 kg/ha) than all other systems. However, inclusion of legume as intercrop made the system sustainable with no significant changes in soil fertility at the end of crop sequence. This system can be managed under good input management in Telangana.

Cost of Technology

An additional cost of Rs. 7949 was incurred in Bt cotton and green gram (1:2) - maize for green cobs system and resulted in an additional net returns of Rs.18346 than the popular maize-groundnut system.

Impact and Benefit

Bt-cotton is widely grown in Telangana even in poor soils. Inclusion of legumes in the system will improve the soil fertility and increases the productivity. Cultivation of maize for green cobs as a sequence crop is also highly remunerative in addition to provision of palatable nutritious green fodder to the livestock.

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Field Crop, Horticulture and Livestock Integrated Farming System for Southern Telangana

Salient Features

Field crop, horticulture and livestock in IFS model (1 ha) is integrated (by allocating 0.7, 0.2 and 0.1 ha, respectively). Horticulture included fruit crop guava and seasonal vegetable and livestock included 2-Murrah breed buffaloes, 6-Osmanabadi goats and 20 Vanaraja backyard poultry birds. Complementary units like vermicomposting and composting are included for residue recycling in the system.

Performance

A productivity of 31.4 t Rice Equivalent Yield/ha was obtained in the IFS. Annually, 2595 kg of cereals, 166 kg pulses, 388 kg oilseeds, 2301 litres of milk, 1157 kg of vegetables are produced from one hectare in the system. Feed and fodder requirement of livestock unit can also be met through average production of 23,400 kg green fodder and 4262 kg dry fodder compared to the demand of 17,500 kg green fodder and 3000 kg dry fodder for animal components in this IFS.

Cost of Technology

Annual cost is Rs.3,19,713; gross returns is Rs.4,42,365 and net returns is Rs.1,22,653.

Impact and Benefit

Through residue recycling and manure production, on an average, 12657 kg of FYM and 1755 kg of vermicompost can be produced which is equivalent to 135-77-103 kg NPK and thus a saving Rs.9000 on fertilizer cost is realised. This helped in improving the organic carbon content (0.36 % to 0.49%) of the unit. System also generates an average employment of 806 man-days and an opportunity to save around Rs.94,320 worth of labour wages per year through engaging farm family labour. System provides nutritional security to farm family in addition to good marketable surplus of several commodities.

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Diversification of Farming Systems for Doubling Farm Income

Greengram preceding to *kharif* rice

Vanaraaja-back yard poultry

Salient Features

Interventions were evaluated for diversification of farming systems *viz.*, crop + dairy; crop+ dairy + poultry; crop + dairy + sheep and crop + dairy + sheep + poultry with climate smart crops and livestock to double the income of marginal farmers.

Performance

The mean holding size is 0.88 ha, with 2-3 buffaloes/cows, 16-20 sheep and 16-20 backyard poultry. Pre-interventional bench mark rice equivalent yield from four farming systems were 4756, 5661, 6783 and 7229 kg, respectively. Introduction of green gram preceding to *kharif rice*, rice-zero till maize, cotton + redgram (4:1), cotton + green gram (1:1) and cotton-maize sequence were the interventions in crop. In livestock improved back yard poultry, improved feed and maintenance of livestock health were tested. Product diversification was through nutritional kitchen gardening, vermicomposting, and selling of milled rice.

Rice equivalent yields improved by about 123% both in crop + dairy + sheep (15185 kg) and crop + dairy + sheep + poultry (16150 kg) than bench mark yields (6783 kg and 7229 kg respectively). In crop + dairy (7398 kg) and crop + dairy + poultry (8695 kg) enhancement was up to 55% over the bench mark yield (4756 kg and 5661 kg respectively).

Cost of Technology

Interventional costs ranged from Rs. 26046 to Rs. 39930 with additional net returns of Rs. 54552 to Rs.123333 over bench mark net income of Rs. 32548 to Rs.50667 in various farming systems.

Impact and Benefit

In all the systems 2-3 times higher net income than bench mark was realised with generation of 660 man days. Diverse components in the farm assured healthy and nutritious food to the farm family. Value addition helped in fetching higher market price for the produce.

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Improvement of Farming Systems for enhanced Profitability and Livelihood of Small Farmers

Drum seeding of RNR 15048

Preparation of improved feed

Salient Features

Small farmers practice crop + dairy + poultry and crop + dairy + sheep + poultry farming systems. The mean holding size was 1.27 ha, 2-3 buffaloes/cows, 20-25 sheep and 15-20 birds.

Performance

Introduction of Siddi and RNR 15048 varieties, direct sowing with drum seeder, *Sesbania* green manure preceeding to *kharif* rice and AWD technique for irrigation, cultivation of perennial fodder (hybrid Napier bajra), *Azolla* production, timely vaccination and deworming, preparation of urea enriched paddy straw, vermicomposting interventions improved the rice equivalent yields in crop + dairy + sheep + poultry (19364 kg) and crop + dairy + poultry (13275 kg) by 105 and 63% higher compared to respective bench mark yields (9444 and 8126 kg).

Cost of Technology

The interventional cost ranged from Rs. 32400 to Rs. 41409 with additional net returns ranging from Rs. 73433 to Rs.105110 and the overall returns were higher than the bench mark net income (Rs.70570).

Impact and Benefit

Round the year money flow keeps the farmer away from institutional or private borrowings. Residue recycling curtailed 50% costs on fertilizers. Food and nutritional security of farm family is ensured.

Composting of crop residues

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Profitable *Melia dubia* Based Silvi-Pastoral System for Rainfed Marginal Lands

Salient Features

Cereal fodders such as fodder maize and sorghum grow well in *Melia dubia* based silvi-pastoral system. Even under marginal lands, also cereal fodder can be grown and optimum biomass production can be obtained. The fodder will be available both from trees and crops.

Performance

In *Melia dubia* based silvi-pastoral system, performance of fodder maize is better than sorghum. The nutrient management practice by application of 50 kg N/ha through inorganic fertilizer + 50 kg N /ha as FYM performed better in terms of higher fresh biomass (5387 kg/ha), crude protein (5.16%) and crude fiber (32.86%) as compared to 75 kg N/ha through inorganic fertilizer + 25kg N as poultry manure (4987 kg/ha, 4.64% and 27.41% respectively).

Cost of Technology

The cost of cultivation of this system is Rs.8,000/ha (fodder maize alone as trees are planted only once)

Impact and Benefit

In *Melia dubia* based silvi-pastoral system in marginal lands, the wood of *Melia dubia* fetches higher price as it is a good raw material for plywood industries. The soil fertility status of silvi-pastoral system in marginal lands is improved when compared to sole crops *i.e.* without trees due to recycling of crop residues.

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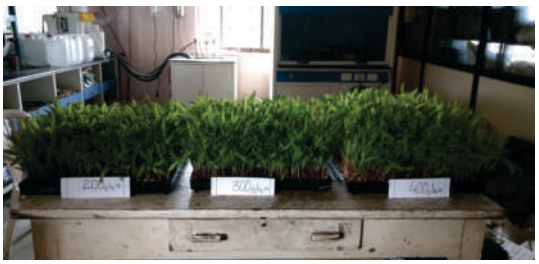
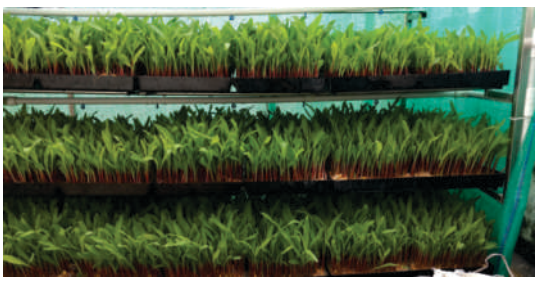
Hydroponic Fodder Production Technology for Dairy Farmers





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Salient Features

Hydroponics is an age old art of growing plants without soil. Today, it is a promising alternate fodder producing technique in land less dairy farms and under rain-fed situation where fodder is un-available in summer due to shortage of irrigation water. Fodder production through hydroponics involves a multi-tier system which can be fabricated by farmers with locally available resources. Primarily this comprises of a multi-tier tray holder for the crop to be grown and an automatic water supply setup for spraying water at 2 hourly frequency until the crop is harvested.

Performance

- Maize is found to be ideally suitable for hydroponic production.
- Seed density should be 200 g/sq. ft (*i.e.*, 2.2 kg/sq m) in the trays.
- Sprouted seed shifted to the hydroponic trays is grown for 9-days and harvested.
- One kilogram of seed gives 4.5-5.0 kg green fodder. Minor variations with respect to days to harvest and seed rates are observed with seasons.
- Harvested crop can be rolled into a mat and fed to the cattle upto 15 kg fodder per day.
- Quality of maize fodder grown using hydroponics is superior to the conventional crop. It contains crude protein - 10%, dry matter - 11%, crude fat - 2.9 %, total mineral ash - 2.9%, and neutral detergent fiber - 59%. A single labour can handle a hydroponic unit with minimum water resource.

Cost of Technology

The installation expenses varies with resources used. A low cost bamboo and plastic tray with a motor system can be easily installed by farmer. However, hi-tech systems are also available in market. In hydroponic system, it costs nearly Rs. 2.75 to produce one kilogram of maize fodder.

Impact and Benefit

This technology has immense potential to overcome the summer scarcity of green fodder besides being very promising for land less dairy farmers. Being less dependent on labour this is also best alternative to labour intensive conventional fodder crop production.

Sweet Sorghum- the New High Yielding Nutritive Fodder Crop

Salient Features

Sweet sorghum varieties are developed for biodiesel production. These are usually fed in the form of bagasse after juice extraction for ethanol extraction. However, these sorghums are very popular among dairy farmers owing to high palatability to cattle. So far four state released genotypes are available in sweet sorghum. These sweet sorghum when grown for fodder can be harvested at 50% flowering and fed to cattle as green fodder or dried as hay and fed as dry fodder. In either way these crops are highly palatable to cattle and very nutritive.

Performance

Among released sweet sorghum genotypes *viz.*, SSV84, CSV19SS, CSH22SS and CSV24SS, CSV19SS possess highest potential for green fodder yield of 42.8 t/ha when harvested at 50% flowering. The quality parameters *viz.*, crude protein 9.87% and brix 9.5% were superior, which makes it more palatable to cattle. Response to applied fertilizers was prominent up to 100 kg N/ha along with 40 kg P_2O_5 and 40 kg K_2O/ha. Besides, it could be harvested at 70-75 days clearing the land for next crop.

Cost of Technology

It requires 7.5 kg of seed per hectare and costs around Rs. 120/kg seed. Farmers can invest Rs.900 on seed of this crop to reap a very nutritive, highly palatable and high yielding green fodder for cattle.

Impact and Benefit

Sweet sorghums are robust high yielding and highly palatable type of sorghums when compared to the fodder sorghums available in market for cattle feed. These sweet sorghums unlike fodder varieties are single cut and yield nutritionally high quality green fodder with respect to crude protein and sugar content. The palatability is so high that even as dry fodder the cattle prefer them to all other sorghums. It incurs only a few hundred rupees extra to farmers to reap a valuable crop of sweet sorghum.

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De-topping to Increase Fodder Yield without Loss of Cob Yield in Maize

De-topping at 40 days after tasseling

Salient Features

De-topping is one of the important management practices adopted by maize growers to get more green fodder without sacrificing the grain yield. Feeding fodder to milch animals increases the milk yield. It has an additional advantage of avoiding lodging problem in fertile soils and also aids better seed production. Farmers de-top maize plants to facilitate pollen to reach silk directly and result in better seed setting.

Performance

De-topping by leaving five leaves above the cob at 40 days after tasseling resulted in grain yield similar to whole plants. Additional green fodder yield of 2 tons/ha is obtained with this de-topping. Excessive de-topping resulted in 17 to 22% yield loss.

Cost of Technology

Cost is Rs. 4000/ha.

Impact and Benefit

This technology can be promoted for the benefit of dairy and seed production farmers. In adopting this technology, farmer will invest Rs. 4000/ha as expenditure but get an additional income of Rs. 10000/ha by sale of green fodder.

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Defoliants as an Aid to Harvest of Greengram

Untreated Greengram crop at harvest

Paraquat treated greengram at harvest

Salient Features

Manual harvest of greengram is labour intensive. Hence mechanical harvesting is an option to overcome labour shortage and to reduce production costs. Greengram foliage does not abscise or detach completely from plants when pods are dry. To facilitate mechanical harvest, defoliation of the crop with the spray of herbicides such as paraquat is a potential option.

Performance

Spray application of paraquat @ 4 ml/l of water in greengram at physiological maturity (a week before harvesting) can facilitate machine harvest. Residues of paraquat are not traceable either in grain or haulm.

Cost of Technology

The cost of harvest is reduced with paraquat application (Rs. 960/acre).

Impact and Benefit

This technology increases labour efficiency because of less interference of leaves during harvest of pods. The mechanical harvest also helps to avoid discoloration of seed.

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Optimum Time of Sowing in *Rabi* for Seed Production of *Sesbania*

Dhaincha in pod development stage

Dhaincha at maturity stage

Salient Features

Sesbania (locally known as *Dhaincha*) is an ideal green manure crop for *kharif*. Seed cost is very high and is mostly imported to Telangana from North India. In rice fallows with zero or minimum tillage, *Sesbania* can be raised for seed production with 1-2 irrigations.

Performance

Seed yield of 1200 kg/ha can be realized when *Sesbania* is sown between third week of November and second week of December.

Cost of Technology

The cost of cultivation of *Sesbania* is Rs.8000 / ha.

Impact and Benefit

Instead of keeping the land fallow, farmers can realize an additional income of Rs.36000/ha through sale of seeds. Quality seed can be made available to farmers at reasonable price. Further, incorporation of leftover crop residue can improve soil organic content and produce more yields with less fertilizer use in the succeeding crop.

Dhaincha at different growth stages

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Safflower Herbal Tea for Increasing Farmers Income in Rainfed Area

Harvesting of Petals

Harvested Petals

Salient Features

Safflower production can become profitable if petal yield complements the seed yield. Twin benefit can be reaped with no extra inputs. Safflower petals can be harvested with ease from non-spiny varieties like NARI-6 and JSI-99. The herbal tea made of dried safflower petals has tremendous health benefits.

Performance

Under optimum management conditions, about 80 to 100 kg of safflower petals can be reaped from one hectare area with non-spiny safflower crop. For collecting one kilogram (kg) of petals, about 3 labourers are required. Presently, the raw safflower petals are sold @ Rs. 3000/kg as herbal tea by ARS, Tandur on a limited scale under University brand name of "SAFFOTEA". As petals are harvested 10-15 days prior to the harvest *i.e* at crop maturity, it provides additional income to the farmer over and above the income from main produce of seed.

Cost of Technology

In safflower, petal harvesting cost is Rs.600/kg, obtaining the by-product involves no additional cost. The income from the petals is complementary to the income from seed.

Impact and Benefit

If the farmers get 50 kg petal yield/ha, an additional gross profit of Rs.50,000/ha can be obtained (Rs.1000/kg).

SAFFOTEA-the Commercialized product of PJTSAU

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Preparation of Vermicompost Using Uprooted Cotton Stalks

Uprooted cotton stubbles

Chopping of cotton stubbles

Vermicomposting of cotton stubbles

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Salient Features

Use of organic manure is essential to improve and maintain physical and chemical properties of soil and also to ensure supply of micro-nutrients. Utilization of locally available crop residues to prepare organic manures in large quantities will aid in alleviating the manure deficit arising out of cattle shortage. It is estimated that about 15 million tonnes of cotton plant stalks are generated each year in our country annually and this resource can be potentially used as a source of nutrient.

Compost pits of 75-90 cm in height, 90-150 cm width with a length of 6-9 metres under shade are ideal depending upon availability of space and cotton stubbles. Uprooted cotton stalks are chaffed into pieces and filled in compost pits along with cow dung slurry, and finally the pits are covered with a layer of cow dung. It is important to sprinkle water constantly to keep the pits in moist condition. Earthworms @10 kg/ pit are released in pits after complete decomposition of cotton stubble pieces by 25-30 days after filling of pits. Earthworms can be obtained from State Department of agriculture or from private hatcheries sanctioned by the department. The pits are maintain in moist condition for further period of 25-30 days during which the decomposed material will be converted to vermicompost. Vermicomposting should be planned in such a way that it is available to farmer in the first week of June coinciding with the beginning of the growing season and hence there is no need to store the vermicompost.

Performance

About 40 quintals of vermicompost will be produced from cotton stalks generated from one acre. This 40 q at a market price of Rs.500/q can fetch Rs.20,000/acre as gross profit.

Cost of Technology

Unit cost of the pit is Rs.3000/acre of stubbles

Cost of operation is Rs.2000/ acre of stubbles

Impact and Benefit

Problem of non-availability of vermicompost will be solved where cotton is the major crop.

Silage Preparation in Polythene Bags

Salient Features

Traditional practice is to prepare silage in silos, pits or towers to overcome lean periods of fodder availability. Silage can be easily prepared in thick polythene covers. Polythene bags of 50 kg capacity of >100 micron thickness (double covered) or > 200 micron polythene bags (single cover) are used to prepare silage.

Performance

Fodder of maize, sorghum or bajra harvested at late dough stage are chopped to less than an inch or 2.5 cm pieces and filled in polythene bags. Air inside is removed carefully by pressing empty remaining space in the bag. Moisture content of chaffed material should be less than 65%. The approximate moisture level of chopped silage can be determined by means of a "grab test." Squeeze the chopped forage tightly into a ball for 20 to 30 seconds and then release quickly. An easily falling out ball without any juice/sap oozing out is clear indication of ideal moisture content (< 65%) for ensiling. Additives used like legume foliage (up to 5% of silage weight), jaggery (2%) and salt (1%) can be added during ensiling after ensuring proper mixing with chaffed matter. After filling the bag with chaffed material, the air in the bag must be completely expelled by thorough pressing and bag is sealed with adhesive tape. Care must be taken to store these bags under shelter.

Silage is ready within 45 days which is indicated by its golden yellow colour, sweet sour pungent smell and low pH values (around 4.0). One adult cattle can be fed with 20 kg of this silage per day.

Cost of Technology

One kg of polythene bags of 50 kg capacity and > 100 micron thickness will cost Rs. 160 and contain 6 individual bags. Thirty kg of such bags costing Rs.5000 can help farmer to feed two milch cattle and to overcome three months of lean period. Other costs of chaffing, filling and sealing silage bags would equate to daily requirement of labour for cutting, chaffing and feeding animals by conventional method.

Impact and Benefit

Silage preparation in polythene bags is a boon to small and marginal dairy farmers as this method is a cheaper alternative to high investment masonry tower or pit silos.

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Services for Testing and Certification on Quality of Food Products


National Accreditation Board for Testing and Calibration Laboratories
(A Constituent Board of Quality Council of India)

CERTIFICATE OF ACCREDITATION

MFPI-QUALITY CONTROL LABORATORY

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2005

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

EEI Campus, Professor Jayashankar Telangana State Agricultural University
Rajendra Nagar, Hyderabad, Telangana

in the field of

TESTING

Certificate Number TC-6135 (In lieu of T-3612)
Issue Date 14/10/2017 Valid Until 13/10/2019

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.

Signed for and on behalf of NABL

N. Venkateswaran
Program Director

Anil Relia
Chief Executive Officer

Contact
Principal Scientist & Head
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Salient Features

MFPI- Quality Control Laboratory, PJTSAU is accredited by NABL (National Accreditation Board for Testing and Calibration Laboratories). It provides an array of analytical services for raw food grains and processed food products. MFPI-QCL implements upgraded Quality Management System as per ISO/IEC 17025:2005.

The lab provides analytical services at affordable prices for farmers, small scale entrepreneurs, research organizations and research scholars on commercial basis. The lab has developed expertise with high standards in nutritional profiling, estimation of vitamins, fatty acid and amino acid profiling, analysis of micronutrients, heavy metals and microbiological testing in raw and processed foods.

Performance

Quality Management System includes demonstration of competence by participation in Proficiency Testing and Inter-Laboratory Comparison for scope matrices. It documents the compliance to ISO/IEC:17025-2005 through Standard Operating Procedures for equipment usage, handling, test protocols, training of technical staff etc,. The lab utilizes reference material traceable to International Standards (NIST). It has a document control facility to ensure high degree of precision and accuracy of test results. Continuous improvements are made through customer feedback in handling customer complaints quickly and efficiently.

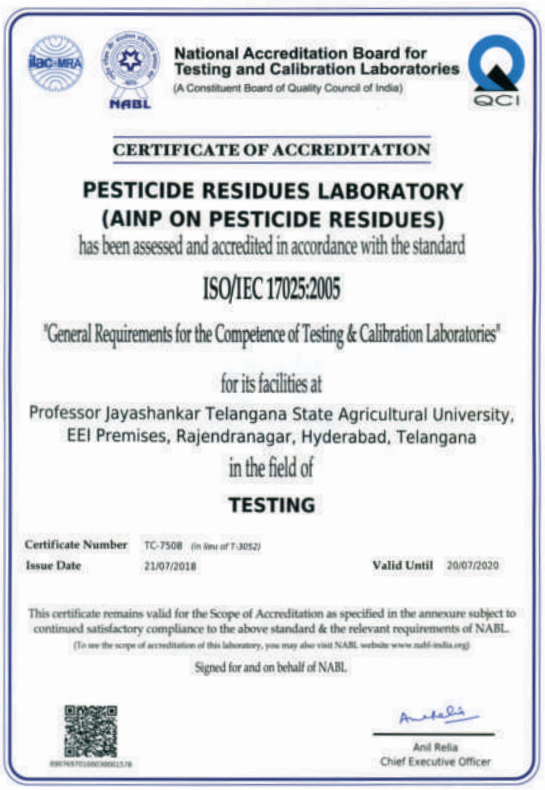
Cost of Technology

Cost of analysis per sample: Proximate analysis(Rs.1785), Minerals (Rs1060), Vitamins (Rs.5495), Sugars (Rs.1525), Nutritional profiling(Rs.6080), Anti nutritional factors (Rs.4280), Organoleptic and Cooking quality(Rs.950), Grain quality (Rs.350), Microbial testing (Rs.6370), Antimicrobial testing (Rs. 3400), Radiation processing (Rs. 480).

Impact and Benefit

Availability of an accredited food testing laboratory with ISO/IEC: 17025-2005 Quality Management System provides a strong science based approach towards food related research, and its utilization for value addition. This facility will help the stake holders like the farmers and sellers of un-branded and branded products in food chain to obtain the legal labeling requirements of Food Safety and Standards Authority of India.

Pesticide Residue Testing Services



National Accreditation Board for Testing and Calibration Laboratories
(A Constituent Board of Quality Council of India)

CERTIFICATE OF ACCREDITATION

PESTICIDE RESIDUES LABORATORY
(AINP ON PESTICIDE RESIDUES)
has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2005

'General Requirements for the Competence of Testing & Calibration Laboratories'

for its facilities at

Professor Jayashankar Telangana State Agricultural University,
EEI Premises, Rajendranagar, Hyderabad, Telangana

in the field of

TESTING

Certificate Number TC-7508 (in lieu of T-3052)
Issue Date 21/07/2018 Valid Until 20/07/2020

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.

(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Signed for and on behalf of NABL.

Anil Relia
Chief Executive Officer

Contact
Principal Scientist & Head
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Salient Features

The Pesticide Residue Laboratory (AINP on Pesticide Residues) is the first laboratory of the University to be awarded NABL (National Accreditation Board for Testing and Calibration Laboratories) accreditation as per ISO/IEC 17025:2005 during 2014 which has been renewed up to 2020 for residue analysis of 71 pesticides on LC MSMS. The laboratory is equipped with the state-of-art equipment like UPLC, Gas Chromatography (GC) with ECD, FID and NPD detectors, GC-MSMS (TQD), LC-MS/MS (TQD) in addition to HPLC.

Performance

The laboratory is equipped to determine pesticide residue through validated standard methods with an accuracy up to 0.05 ppm on GC-MS/MS and 0.01 PPM on LC-MS/MS. Quality Manual, Quality System Procedure, Forms and Formats, Standard Operating Procedures and working instructions are available and are implemented to achieve a high level of traceability. Methods and procedures have been standardized for determination of pesticide residues and their dissipation dynamics in different matrices like fruits, vegetables, cereals and pulses for over 70 pesticides helpful in fixation of MRL s and PHIs. The lab has received commendable Z scores (-2 to +2) in international and national proficiency testing that is evidence to the scientific proficiency of the lab.

Cost of Technology

Ranges between Rs. 2000 to 10,000 based on purpose, type of instrumentation used for Pesticide Residue Analysis in different food commodities.

Impact and Benefit

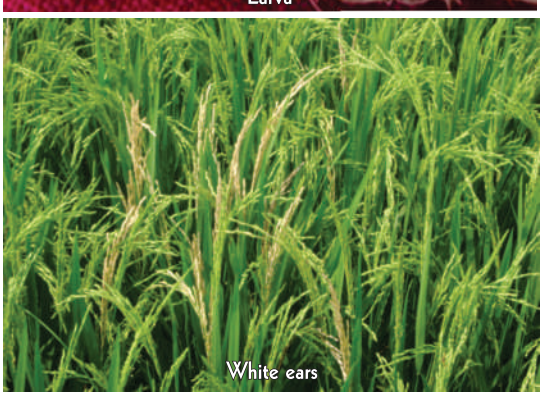
The laboratory is a valuable asset, enhancing the profile of PJTSAU as it provides residue analysis services as per NABL standards at affordable prices to various stakeholders. Database generated at the lab on pesticide residues detected in various food commodities in the state of Telangana and Andhra Pradesh aids in taking necessary corrective actions in bringing awareness among the farming community on the safe use of pesticides.

Novel Insecticide Molecule for Management of Rice Yellow Stem Borer


Female


Eggmass


Larva


White ears

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E-mail: psrice2009@gmail.com

Salient Features

Rice yellow stem borer, *Scirpophaga incertulas* (Walker) is a predominant pest causing considerable yield loss (20-40%). Major loss in yield occurs at reproductive stage, in the form of white ears.

The widely used insecticides against stem borer *i.e.* acephate, flubendiamide or cartap hydrochloride etc., are either ineffective or moderately effective at reproductive stage of the crop, warranting identification and use of new and more effective molecules.

Performance

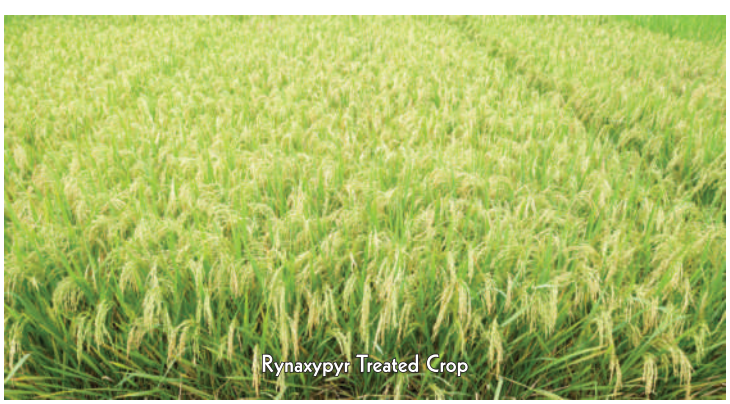
Rynaxypyr 20SC @ 0.3ml/l was evaluated for its efficacy against rice stem borer. One spray during panicle initiation (PI) to booting stages resulted in 80 to 100% control of stem borer (0.00 to 3.06%WE) over untreated control (10.96 to 30.55%WE) with an additional yield of 0.5 to 1.2t/ha.

Cost of Technology

The cost of spray application of Rynaxypyr is Rs. 830/- (for one spray @ 60ml/acre).

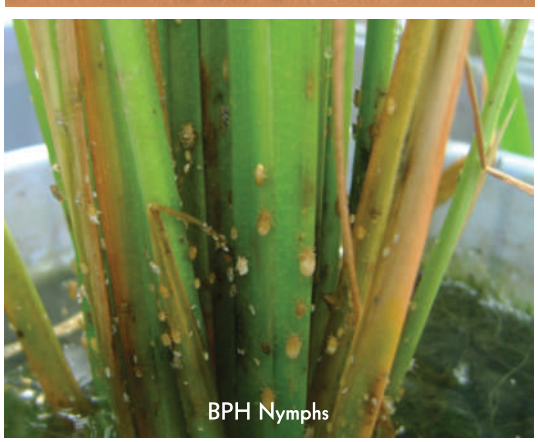
Impact and Benefit

- It will ensure judicious use of insecticide for effective management of stem borer.
- Spraying of identified insecticide only once reduces the stem borer population and plant protection cost.
- Based on recommendations of PJTSAU, farmers of Telangana are widely using Rynaxypyr for stem borer management, particularly at reproductive stage.


Rynaxypyr Treated Crop

Novel Molecules to Manage Brown Planthoppers (BPH) in Rice

Hopper burn



BPH Nymphs

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Salient Features

Brown planthopper (BPH) is an important pest causing considerable damage to rice crop in Telangana, particularly during *kharif*. Of late, the pest is showing an increasing trend owing to indiscriminate use of insecticides and cocktail mixtures of two or more insecticides or agrochemicals like bio-products leading to resurgence of this pest.

Performance

Dinotefuran 20 SG @ 0.40 g, Imidacloprid 40 WG in combination with Ethiprole 40 WG @ 0.25 g or Triflumezopyrim 106 SC @ 0.48 ml/l of water were highly effective in controlling BPH.

Cost of Technology

Cost of Dinotefuran 20 SG is Rs. 680 per acre (@ 80 g insecticide/acre), Imidacloprid + Ethiprole costs Rs. 550 per acre (@ 50 g insecticide/acre), Triflumezopyrim costs Rs. 1400 per acre (@ 94ml insecticide/acre)

Impact and Benefit

Judicious use of insecticide offers timely and effective insect control. Dinotefuran or a combination of imidacloprid with ethiprole is widely used by farmers to manage BPH. Additionally, triflumezopyrim has been recently launched. These insecticides were found relatively safer to beneficials like spiders and coccinellids and therefore maintain ecological balance. These new insecticides can also be used to effectively manage BPH population that have developed resistance to repeated application of neonicotinoid insecticides.

BPH Adults

Compatible Acaricides and Fungicides to Protect Rice Panicle and Grains

Discoloured Grains

Phytotoxicity of Diafenthiuron

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Salient Features

Panicle mite, sheath rot and neck blast are important biotic constraints of *kharif* rice in Telangana, particularly during reproductive stage resulting in direct yield loss (> 20%) apart from indirect losses of inferior grain quality, discoloration and sterile spikelets. Physically compatible and non-phytotoxic combinations for panicle mite, sheath rot and neck blast were identified.

Performance

Dicofol @ 5ml and propiconazole @ 1 ml or spiromesifen @ 1 ml and propiconazole @1 ml/l of water reduced the incidence of panicle mite and sheath rot, and grain discolouration by 55-60%. Therefore, increasing the yield by 650-800 kg/ha.

Similarly, combinations of dicofol, spiromesifen and propargite with carbendazim, tricyclzole, isoprothiolone, kasugamycin, hexaconazole, propiconazole were found to be physically compatible and non phytotoxic. Although physically compatible, diafenthiuron alone, or its combination with any fungicide showed severe phytotoxicity (leaf scorching and yellowing)

Cost of Technology

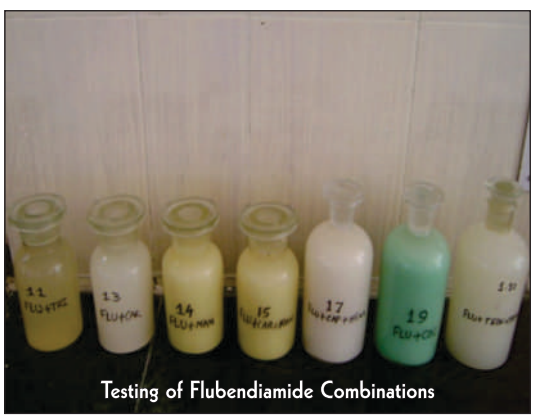
No additional cost is involved.

Impact and Benefit

Physically compatible, non-phytotoxic acaricide and fungicide combinations without any negative effects are recommended. Farmers should avoid phytotoxic tank mixtures involving diafenthiuron. This technology of mixed compatible pesticides application saves time, cost of labour, energy and equipment by Rs. 500-1000/ha.

Healthy Crop

Compatible Insecticides and Fungicides to Protect Rice Crop from Multiple Pests and Diseases



Testing of Flubendiamide Combinations

Evaluating Bioefficacy

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Salient Features

Farmers are tank mixing the insecticides and fungicides to manage insect pests and diseases of rice without proper knowledge on their compatibility, resulting in either phytotoxicity or inadequate management. Identification of compatible combinations will help the farmers to cut down their spraying costs and enhances bio-efficacy. Further, it aids to evolve economically cheaper and environment friendly pesticide combinations.

Performance

Series of studies were conducted on several insecticides, fungicides and their combinations for use in rice over a period of seven years and a few compatible, cost effective pesticide combinations with good bio-efficacy against multiple pests and diseases in rice were identified.

- Chlorantraniliprole @ 0.3ml and Isoprothiolane @ 1.5ml to control stem borer, leaf folder and blast.
- Chlorantraniliprole @ 0.3ml, Carbendazim @ 1g and Mancozeb @ 2.5g to control stem borer, leaf folder, blast and grain discoloration.
- Chlorantraniliprole @ 0.3ml and Nativo (Trifloxystrobin + Tebuconazole) @ 0.4g to control stem borer, leaf folder, neck blast and grain discoloration.
- Cartap hydrochloride 50 SP @ 2g, Carbendazim @ 1g and Mancozeb @ 2.5g to control stem borer, leaf folder, blast and grain discoloration.
- Cartap hydrochloride 50 SP @ 2g and Propiconazole @ 1ml or Chlorantraniliprole @ 0.3ml and Propiconazole @ 1ml to control stem borer, leaf folder, sheath rot and grain discoloration.
- Flubendiamide 480SC @ 0.1ml, Carbendazim @ 1g and Mancozeb @ 2.5g to control stem borer, leaf folder, blast and grain discoloration.

Cost of Technology

No additional cost is involved.

Impact and Benefit

This technology of mixing compatible pesticides saves time, cost of labour, energy and equipment by Rs. 500-1000/ha.

Identification of New Sources as Donors for Resistance to Rice Gall Midge (Biotype 4M)

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Salient Features

Gall midge is an important pest causing considerable damage (upto 70%) to rice crop in Telangana during *kharif*, particularly under late planted or delayed monsoon conditions. Warangal is an endemic area for gall midge with local biotype designated as biotype 4 M.

Identification of resistant sources and evolving resistant varieties is the most effective method for combating rice gall midge without any extra cost on plant protection.

Several rice genotypes were screened against gall midge using both conventional and molecular approaches and resistant sources against these pests were identified.

Performance

Following are the identified resistant sources against gall midge biotype 4M through intensive screening:

Highly resistant entries: Aganni, JGL-19618, Vellailankalyan, Sudu Hondarawala, WGL 1145,RP-1, MAS-W-253, Sinna Sivappu, PTB-12, RMSG-10, THBR-68, THBR-69, RP 4686-48-1-937, BR-98-425-C3, WGL-1129 (MAS-W-74), WGL-1139 (MAS-W-218), KAKAI (1417), TH BR 70, WGL-1143, WGL-1127 (MAS-W-66), and MAS-W-194.

Resistant entries: IC-577036, IC-466408, IC-466352, WGL-1133 (MAST-82), PTB-32, THBR-71, WGL-1146, WGL-1119, WGL-1131, BR-89-382-C3, BR-89-383-C3, BR-97-419-C3, BR- 99-430-C3, WGL-1147, WGL-1141 and BR-93-393-C3.

Cost of Technology

To use resistant donors, no additional cost is involved.

Impact and Benefit

- New donors (WGL 1127 and 1145) have been identified at national level for use in breeding programme to develop new resistant varieties against gall midge biotype 4M.
- Identified sources of resistance in advanced breeding material can be released as varieties. WGL 1119 has completed multilocation testing and approved for minikit testing.
- Resistant varieties would become a major component in IPM.

New Potential Sources for Use as Donors for Resistance to Rice Planthoppers

BPH Population

Field Screening of BPH

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Salient Features

Crop damage due to planthoppers (PH) is on an increasing trend in Telangana. Problem is aggravated because of improper management practices used at farmers' level. Identification of resistant sources and evolving resistant varieties is the most effective method of combating insect pests without any extra cost on plant protection. Several rice genotypes were screened against mixed population of planthoppers and resistant sources against these pests were identified.

Performance

Resistant sources identified against PH:

Score 0: BM-71

Score1: CN-1231-11-7, CN-2072, CR-1898-32-69, CN-12-2, RNR 21225, IR10N 396, MTU 1061, MTU 1164, MTU 1001, MTU 20601-1-1-1-1, BPT 2671, CB 05022, CB 09123, RNR 15038, IR 09 N 516 and IR 09A 235.

Score 0.5 to 1.3: IR 09A 104, Milyang 55, NLR-3041, PSBRC-1-2-1-2, IR-10A 135 and IR-10A-155.

Score 3: CR 2711-149, BPT 2776, BPT 2787, CB 14 156, CB 14 161, MO 1, MTU 1211, MTU 1245, MTU 1247, RP 5995Bphk17-1, RP 5690-20-6-3-2-1, IR 75870-5-8-5-B-5-B (HWR-15), JGL 20776, JGL 23746, WGL 1021, JGL 18629, OR 192-4, ASD-7, RP 2068-18-3-5, Akshaydhan.

Score 1.5 to 3.4: Velluthacheera, Chinsaba (ACC33016), MUT NS1, Mudgo (ACC 6663), Bobukangbu, ARC 10550 and Rathuheenati.

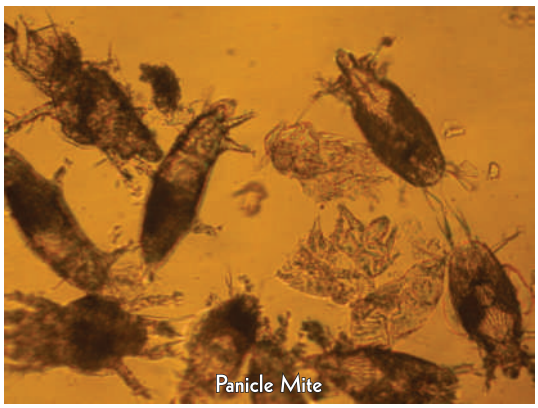
Cost of Technology

To use resistant donors, no cost is involved.

Impact and Benefit

- Identified sources of resistance can be used as donors in breeding programme.
- Identified sources of resistance in advanced breeding material can be released as varieties.
- Resistant varieties would become a major component in the IPM.

Identification of Resistant Sources for Rice Panicle Mite, *Steneotarsonemus spinki*


Panicle Mite


Discoloured & Healthy Panicles

Salient Features

The rice panicle mite infestation starts from leaf midrib, extends to leaf sheath and panicles leading to ill-filled, chaffy or discoloured grains. The yield losses due to panicle mite range from 4.9 to 23.7 percent. Of late this mite is posing a threat to rice production in Telangana, owing to low rainfall and high temperatures. No known sources of high level of resistance to panicle mite are available so far.

Performance

Among 20 rice varieties/ genotypes screened during 2015 and 2016 for panicle mite, one highly resistant variety *viz.*, Karimnagar Samba (JGL 3844) and two moderately resistant genotypes *viz.*, RNR 15038 and RNR 17497 were identified.

Cost of Technology

There is no additional cost in using resistant donors.

Impact and Benefit

- This is first of its kind study against rice panicle mite.
- Aids in breeding and development of panicle mite resistant varieties.


Healthy Grains of JGL 3844

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Chemical Control of Maize Stem Borer *(Chilo partellus)*

Dead Heart

Shot Holes Due to Stemborer

Salient Features

Chilo partellus (Swinhoe) is one of the serious pests of maize in Telangana. It is the most damaging insect pest causing yield losses from 27 to 80% during *kharif*. A prophylactic spray application of chlorantraniliprole 20 SC @ 0.3 ml/l of water or 60 ml/acre on 10-15 days old maize crop provided an effective control of stem borer.

Performance

The stem borer control efficiency of chlorantraniliprole is 7.34% higher than the farmers practice of application of monocrotophos. By spending an additional cost of Rs.806/acre, farmer can realize yield of 10.4q/ha and net profit of Rs.4602/acre.

Cost of Technology

Cost is Rs. 806/acre.

Impact and Benefit

Chlorantraniliprole has replaced banned chemical endosulfan that was earlier recommendation for control of stem borer in maize. About 20-25% of maize farmers are now using chlorantraniliprole. Because of this technology, optimum plant population could be maintained and productivity gain of 15% could be achieved.

Healthy Crop

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Novel Insecticide Molecules for Sucking Pest Management of Cotton through Stem Application

Stem Application

Using stem Applicator

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Salient Features

Sucking pests significantly affect crop growth and limit rainfed cotton yield (12%). Farmers resort to repeated foliar application of insecticides for suppression of these pests, which not only effects beneficial insect fauna but also leads to development of insecticide resistance apart from serious environmental consequences. Therefore, a cost effective and eco friendly method of stem application method in cotton @ 30, 45 and 60 DAS was devised and new insecticide *viz.*, Flonicamid 50% SG was identified for effective management of sucking pests up to 60 days after sowing.

Even though Monocrotophos and Imdicaloprid were identified as promising for stem application method for sucking pest management, resistance to Imidacloprid has been reported warranting need for alternate chemicals for sucking pest management in cotton. Therefore, some novel insecticide molecules were evaluated through stem application method to identify alternative chemicals to Imidacloprid.

Performance

Different insecticides *viz.*, Flonicamid 50% SG, Thiamethoxam 25WG, Fipronil 5% SC, Acetamiprid 20 SP, Clothianidin 50%WDG, Imidacloprid 17.8% SL and Monocrotophos 36 SL were evaluated against sucking pests of cotton through stem application method along with control.

Monocrotophos was found to be good for stem application method against all sucking pests. Flonicamid (1:20 ratio) has been identified as better alternative to Imidacloprid in reducing sucking pests mainly Aphids (22%) and Jassids (39%) and realized 10% additional yield compared to Imidacloprid.

Cost of Technology

The benefit cost ratio of stem application technology with Flonicamid is 2.26.

Impact and Benefit

- It effectively controls the sucking pests and safer to natural enemies.
- Low cost of protection.
- It minimizes the pesticide residues in ecosystem.
- The amount of water required is meager, hence water saving technology.

Compatible Combination of Insecticides to Control Sucking Pests in Cotton


Aphids


White Fly

Salient Features

Farmers are using different tank mixtures of insecticides to save time, labour and energy. Spraying of certain incompatible combinations without proper knowledge is resulting in field level problems like phytotoxicity, defoliation and crop losses.

Performance

A combination of acephate75% SP (1.5 g/l) and fipronil 5% SC(2 ml/l) or acetamiprid 20% SP (0.2 g/l), monocrotophos36% SL (1.6 ml/l) and fipronil 5% SC (2ml/l) can be spray applied by mixing, to control sucking pests.

Cost of Technology

No additional cost is involved.

Impact and Benefit

Insecticide combinations depending upon pest situation may be chosen for better efficacy and effective control of the pest, which results in less number of sprays and saves cost of spraying to an extent of Rs.500-600 per acre.


Jassid Damage

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Integrated Pest Management in *Bt* Cotton

Sorghum as Border Crop

White ears

Salient Features

IPM adoption rate in the field is low, mainly due to non-availability of IPM components at farmers' door steps. Demonstrations are needed to popularize and minimize chemical usage. IPM can reduce the overall cost of cultivation, prevent harmful effects to natural enemies and resistance to insecticides, safeguard environment and to provide higher benefit with optimum yields to farmers.

Performance

IPM practices like intercrop with greengram or cowpea (1:1), stem application (Monocrotophos36% SL and water diluted @1:4 at 30, 45 DAS and with Imidacloprid 17.8% SL and water diluted @1:20 at 60DAS), need based spray with 5% NSKE or Neem oil (1500 ppm) @ 5 ml/l, pheromone traps @ 4 per acre, bird perches (10 per acre), yellow sticky traps (10 per acre), growing border crop (sorghum @ 2-3 rows) and need based plant protection measures 60 days after sowing (based on Economic Threshold Levels) with rotation of pesticides are useful and superior over farmers practice. IPM also reduces the cost of cultivation. IPM plots registered a benefit cost ratio of 1:1.6 over farmers practice (1:1.4).

Cost of Technology

The cost of cultivation with adoption of IPM practices is lower than farmers practice by Rs.1000/acre.

Impact and Benefit

The sucking pest populations in IPM fields are low compared to plots under farmers practice. IPM gives additional monetary benefit and also helps to reduce pesticide consumption.

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Creating Awareness on Insecticide Resistance Management (IRM) in Cotton

Discussing on IRM

Creating Awareness to Farmers

Salient Features

Resistance to a pesticide is developed in insects exposed to the same insecticide repeatedly at extremely low or high doses. The IRM is meant to overcome the existing resistance crisis through specific strategies to ensure efficient pest control and mitigate the problem of resistance in pests to pesticides. The IRM project was implemented in two villages (Kannayapally and Kanchanapally) of Warangal district in an area of 150 acres and the impact was compared with farmers practices.

Performance

Window I - Early sucking pest infestation (up to 60 days): Seed treatment with imidacloprid (Gaucho 600FS) @ 5ml per kg seed, removal of alternate weed hosts around fields, stem application of monocrotophos 36% SL at the ratio of 1:4 in water at 30, 45 and 60 days after sowing (DAS) and spraying of neem seed kernel extract (5%) or Neem oil (1500 ppm) @5ml/l in addition to stem application depending on the pest load

Window II - Initial bollworm infestation (60-80 days): Spray with neem kernel extract (5%) or neem oil (1500ppm) @ 5ml/l is adopted.

Window III - Peak bollworm infestation (80-100 days): To manage boll worms, one spray with spinosad @ 0.4 ml or chlorantraniliprole @ 0.3 ml/l of water is adopted. In this period the number of insecticide applications is normally more in non-IRM villages than in IRM villages.

Window IV - Bollworm and mealybug infestation (100-120 days): Incidence of pink bollworm is noticed during this period. One round of Thiodicarb (@1.5g/l) is sprayed along with neem oil (1500ppm) @ 5ml/l to contain the pest. Farmers are advised not to extend crop growth beyond 200 days. Farmers complete 2-3 pickings by the end of January and terminate the crop and dispose stubbles to avoid carryover of the pest.

Impact and Benefit

The cost of production due to adoption of IRM is reduced by Rs.7600/ha (3036/acre) compared to non-IRM apart from reducing sprays by 2-3 rounds.

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New Insecticide for Management of Leafhopper in Castor


Severe Leafhopper Damage


Leafhoppers

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Salient Features

Among the sucking pests, leafhoppers inflict >35% yield losses of *rabi* castor. A new insecticide *viz.*, Clothianidin 50WDG has been identified for effective management of leafhoppers.

Performance

Clothianidin 50WDG, Flonicamid 50WG, Acetamiprid 20SP, Thiamethoxam, 25WG, Profenophos 50EC and Dimethoate 30EC were evaluated along with untreated control against leafhoppers in *rabi* castor during 2014-2017. Among these, two sprays of Clothianidin @ 0.1g/l at 15 days interval resulted in 87% (7.81 leafhoppers / 3 leaves/plant) and 88% (7.62 leafhoppers / 3 leaves/plant) lower population of leaf hoppers respectively, during first and second spray over untreated control (63.59 and 64.92 leafhoppers / 3 leaves/plant, respectively) and realized 55% higher yield (16.35 q/ha) over untreated control (10.48 q/ha).

Cost of Technology

The total cost of two sprays of Clothianidin is Rs. 630/ acre.

Impact and Benefit

A new chemical has been added to the sucking pest management basket of castor, which aided not only in effective leafhopper management but also realized additional benefit (BC ratio of 1.93) to the farmer.


Healthy Crop

New IPM Module for Castor

Farmers Practice Field

IPM Field

Salient Features

IPM modules will aid in minimizing chemical usage, reducing the overall cost of cultivation and harmful effects to natural enemies, combating resistance to insecticides, safe guarding environment and accruing high benefit cost ratio with optimum yields. There is need to demonstrate full advantage of IPM in tackling the insect pest complex in castor.

Performance

IPM module involving application of Btk @ 1 g/l, monitoring of *Spodoptera* using pheromone traps 4/acre starting from 30 DAS, collection and destruction of gregarious stages of defoliators, application of flubendiamide @ 0.2 ml/l for *Spodoptera* at 25% foliar damage was demonstrated during 2014-2017 in comparison to farmers practice of 5-6 sprays of monocrotophos or acephate and untreated control.

Reduced incidence of Spodoptera (0.44/plant) and semilooper (0.87/plant) was observed in IPM module compared to untreated control (4.27 and 7.67/plant, respectively) and farmers practice (1.18 and 1.13/plant). Further, enhanced parasitization of *Snellenius* (63.9%) was observed over farmers practice (31.03%). Higher castor yield was realized (15.32 q/ha) as against farmers practice (12.25 q/ha).

Cost of Technology

The IPM module costs Rs. 1982/acre. A benefit cost ratio of 1.66 was realized over farmers practice (1.35) and untreated control (0.84).

Impact and Benefit

- This technology is safer to natural enemies,
- Usage of insecticides can be minimized by 80%.
- Higher yields (20%) can be realized.

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Non-Chemical Management of Pulse Beetle in Stored Redgram

Pulse Beetle Damaged Grains

Treated Healthy Grains

Salient Features

Among the insect pests attacking stored grains of redgram, the pulse beetle *Callosobruchus chinensis* is the most important, causing about 15-20% storage losses. Fumigation with methyl bromide is the most widely applied management practice for the control of this pest. But it is not safe to human beings and pollutes the environment. Therefore, there is a need to develop safe alternative environment friendly methods.

Performance

Application of vegetable oil like groundnut oil, palm oil, sesame oil, neem oil, mustard oil, sunflower oil or castor oil @ 5 ml/kg seeds effectively reduced pulse beetle damage. The seed germination is more than 80% in treated seeds with oils even after six months of storage.

Impact and Benefit

Application of oils in seed treatment aids in successful management of pulse beetle damage in redgram during storage. It is also safe to environment and humans.

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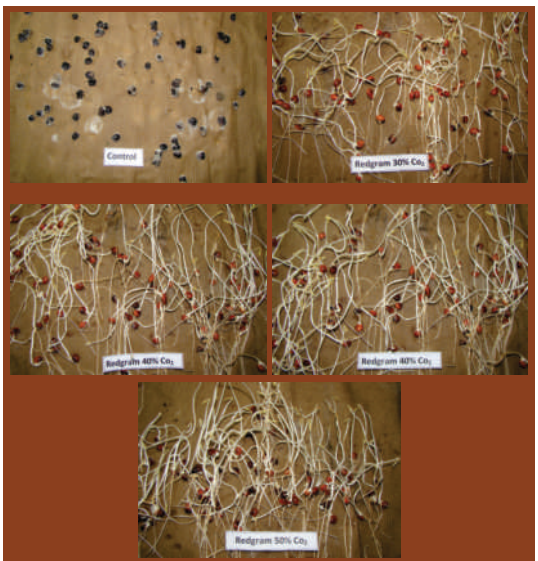
Modifying Atmosphere in Storage Area to Prevent Seed Borne Pests and Diseases



Effect of Carbon Dioxide on seed infestation in Redgram

Salient Features

Changes in the micro climatic conditions of the storage area in containers or well-insulated and sealed storage area or rooms by introducing carbon dioxide (CO_2) prevent any loss of seed physiological activity in addition to controlling microbial population. The modified atmosphere in air tight containers prevents aerobic fungi from growing and kills insects including mites on seed due to elevated CO_2 and depleted O_2 levels. It maintains seed quality for longer period of time without any detrimental effect on seed viability and vigour.

Performance

Paddy: Seeds exposed to carbon dioxide in air tight containers by injecting with CO_2 @ 30 to 40% by volume, protects seeds from any damage to seed quality traits during prolonged storage up to nine months and are effective against the common paddy Angoumois grain moth *(Sitotroga cerealella)*

Pulses: Redgram seeds can be stored up to nine months by injecting with CO_2 at 40% by volume in air tight containers without affecting germination and seedling vigour. It reduces the pulse beetle incidence and storage fungi such as *Alternaria and Aspergillus Spp*.

Cost of Technology

Initial cost of equipment	: Rs. 3 lakhs/unit
Subsequent cost of application of CO2	: Rs. 10/quintal

Impact and Benefit

Commodities including cereals, oilseed grains, pulses and other seeds can be stored safely for longer period to maintain high quality, and this can also be easily adopted for large scale seed storage by seed corporations and seed industries.

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Antibiotic Producing Fluorescent *Pseudomonas* for Increasing Yield and Control of Soil Borne Diseases in Groundnut

Groundnut seed inoculation with microbial culture

Salient Features

Chemical fertilizers are used indiscriminately resulting in decline in productivity and soil fertility. Any build up of microorganisms in the soil will improve soil fertility. INM practices by using bio-fertilizers may possibly maintain the sustainability of crop yields and soil fertility. Inoculation of microbial culture is very much recommended in soils under groundnut cultivation to realize high yields. However, certain microbes in addition to enhancing nutrient use efficiency, also controls soil borne diseases like collar rot, root rot and stem rot. Antibiotic 2,4-diacetylphloroglucinol (2,4-DAPG) or DAPG producing fluorescent *Pseudomonas* are known to suppress soil borne fungal infections.

Performance

200g of DAPG producing *Pseudomonas* is dissolved in 5% jaggery solution and it is treated with one kg. of seed one day before sowing of the crop. Groundnut seed inoculated with either *Trichoderma* spp or fluorescent pseudomonas (FP-98 or DAPG 1 or DAPG 2 strains) recorded higher grain yields (1106-1302 kg/ha) than control (935 kg/ha). A higher BC ratio (1.5) was obtained with DAPG-1. Seed inoculated with *Trichoderma viridi* reduced the incidence of stem and collar rot (6.2% and 2.5%) followed by FP-98 (4.2% and 1.0%) than control (8.7 % and 3.5%). However DAPG-2 treatment recorded less stem and collar rot disease incidence (3.3% and 0.5%) as compared *Trichoderma* spp (6.2% and 2.5%) and FP-98 (4.2% and 1.0%).

Cost of Technology

Use of bio inoculants in groundnut crop is less expensive (Rs. 400-450/ha) than chemical fertilizers.

Impact and Benefit

Higher groundnut yields can be realized with eco-friendly bio inoculation technology besides reducing stem and collar rot diseases.

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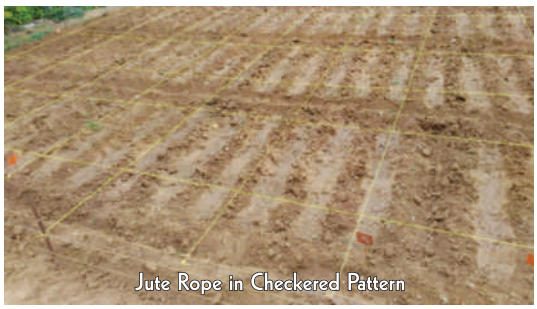
Technology to Reduce Crop Damage from Peafowl



Jute Rope in Checkered Pattern

Jute Rope Around the Crop

Salient Features

Indian peafowl causes serious damage to many crops. Damage from peafowl is more pronounced at seed sprouting stage (42-70%), than at ripening stage (15-35%). Use of physical barriers made of jute or coconut ropes reduces peafowl damage.

Performance

During sprouting and seedling stage of crop, fixing of jute ropes around the crop with the help of pegs at 1 or 2 m intervals, and tying the rope at 30 cm above ground in a checkered pattern forming squares of 1 x 1 m to prevent entry of peafowl into the crop fields is needed. This method has been tested in different crops at various locations and proved effective to reduce peafowl damage by 80 to 95%.

Cost of Technology

The cost involved in installing jute ropes in a pattern of forming squares is Rs.1000 per acre (Rs.700 for jute rope and Rs.300 for labour).

Impact and Benefit

The technology is eco-friendly, cost effective and will reduce damage by 80 to 95%. This technology is tested in several farmer fields and in crops like maize, groundnut and vegetables. In view of severity of damage to crops by peafowl and also as per Indian Wild life Protection Act, this technology has shown an ideal way to reduce the damage to crops during sowing stage without killing birds. It saves manpower and reduces crop losses due to peafowl.

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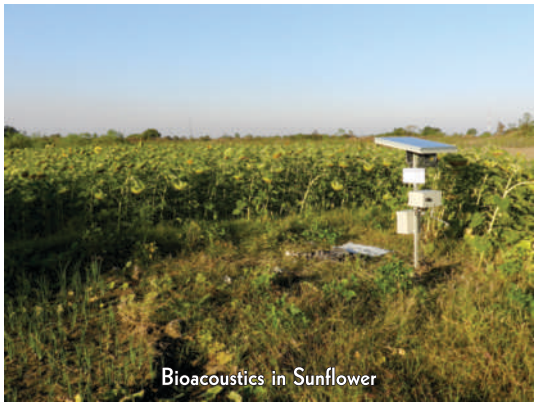
Reducing Crop Losses from Birds Using Bioacoustics



Bioacoustics in Sunflower

Bioacoustics in Sorghum

Salient Features

Bioacoustics is a new technology developed by PJTSAU for decreasing problematic birds in oilseeds and millets. The extent of damage by birds in sunflower and sorghum is 50-70% in isolated areas across different agro-climatic zones. Bird alarm, distress squeak and predator call sequence are embedded in a chip, and a broadcasting platform is designed using a solar panel, battery and speaker.

Performance

This method is very effective in reducing crop losses from birds in crops like sunflower, sorghum, maize, safflower and other major millets by 60-89%.

Cost of Technology

The assembled gadget cost is Rs.20,000/ unit.

Impact and Benefit

Birds are not acclimatized to same call sequences in multiple seasons. The equipment has been demonstrated in farmer fields and it proved its efficacy over an area of 4-5 acres and led to 15% yield enhancement due to reduction in bird damage.

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Reducing Crop Losses from Birds Using Reflective Ribbons, Jute or Plastic Shade Nets

Use of Reflective Ribbons in Grape Orchard

Use of Jute Bags around the Grape Orchard

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Salient Features

In Telangana, grape vine yards are spread in about 587 ha under Y-junction planting and pandal system. In addition to the insect pests and diseases ,birds and bats also cause a significant damage to grape. A total of 12 species of birds cause 35-55% damage to grapes during seed maturity stage.

Performance

Under Y-junction planting system, use of reflective ribbons and jute and plastic shade nets in combination has increased yield by 30-40%. Under pandal planting system, use of jute bags around the grape orchard has protected from bird damage and significantly increased yield of grapes by 25-33%.

Cost of Technology

Cost of reflective ribbon is Rs.1,500/acre. Cost of gunny bags or shade net is Rs.3,500/acre.

Impact and Benefit

This method prevents damage to grapes by different species of birds throughout the season.

Saves manpower and reduces losses due to birds and bats.

Artificial Nest Box Design for Conservation of Insectivorous Birds

Different types of nest boxes

Hon'ble Vice-Chancellor, PJTSAU Observing Nest Box Model

Salient Features

In India nearly 1300 species of birds are reported to occur of which only 486 species are dependent on agriculture, 81 species are considered as depredatory, and remaining are beneficial in nature.

Beneficial birds play a significant role in controlling insect pests of various crops. Among the beneficial birds, 33% of the birds prefer tree holes for nesting and breeding.

Indiscriminate cutting and removal of trees around agricultural fields has led to drastic decrease in the population of many useful insectivorous birds of Agricultural importance.

Therefore, AINP on VPM has developed and standardized the design of artificial nest boxes to suit the different sizes and shapes of birds.

Performance

These artificial nest boxes were tested at different localities. Results showed that nine dominant and agriculturally important bird species successfully accepted these artificial nest boxes for breeding.

The entry hole, box size and its placement were the critical factors in the selection of artificial nest box by the bird species.

Before the start of a breeding season, artificial nest boxes are to be fixed at suitable locations.

Among the nine dominant species, three species (Spotted owlet, Common Myna and House sparrow) were aided to breed successfully (68-88%) in these artificial nest boxes.

Cost of Technology

The cost of the artificial nest boxes ranged from Rs. 10 to 600 per unit depending on the material used.

Impact and Benefit

- The technology is eco-friendly and cost effective.
- Easily acceptable by all the people.
- Promotion of this technology helps in conservation of the species and enhances the targeted bird population in the region.
- These hole nesting birds help in controlling insect pests to an extent of 33-58% in different crops.

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Preventing Damage from Wild Boars in Crops Using HDPE Nylon Net

Salient Features

Wild boars have become a serious menace to production of field crops throughout the country. They sometimes cause more than 60-70% crop damage. As wild boars are highly intelligent animals, integrating several technologies as per local requirements can provide an effective management of wild boars. There are two kinds of potential physical barriers to prevent entry of wild boars into crop field. These are use of high density polythene (HDPE) nylon net and circular blade wire.

High Density Polyethylene (HDPE) Nylon Net

HDPE, UV stabilized 5 cm mesh and 1.5 mm thick Net is fixed vertically using bamboo or wooden poles of about 1 m in height, and the net is then spread to about 60 cm horizontally over the ground by using small wooden pegs. If animal enters, it will be entangled and gives out alarm calls that deter other wild boars.

Performance

HDPE net acts as a good physical barrier. It is effective in preventing wild boar entry into the crop fields to an extent of 70-80%.

Cost of Technology

Cost involved in fixing the net is around Rs. 2000/acre.

Impact and Benefit

It is a cost effective method to protect the crop without harming the animal. Saves manpower, cost and reduces crop losses by wild boar.

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Preventing Damage from Wild Boars in Crops Using Circular Blade Wire

Wild Boar Damaged Maize Crop

Protected Maize Crop with Circular Blade Wire

Salient Features

The mesh consists of iron wire with sharp razor blades. Circular continuous blade wire mesh rolled to 60 cm width is fixed 30 cm away from the cropped area as border. It is suitable to all crops to serve as potential physical barrier.

Performance

This fence causes serious damage to the wild boar when it tries to enter into the field. It effectively prevents the entry and also scares away other animals thereby saving the crop. The entangled animal makes alarm call which deter away the other wild boars.

Cost of Technology

The cost involved will be Rs.20,000/acre (Rs.18,000 for the razor wire and Rs.2000 labor) for fixing the fence.

Impact and Benefit

It reduces crop losses by wild boar to the tune of 75-85%. It is effective in all the seasons and saves manpower used to safeguard the crop.

Protected Maize Crop

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Preventing Damage from Wild Boars in Crops Using Barrier crops

Wild Boar

Safflower as Barrier Crop in Groundnut

Salient Features

Wild boar is an animal with very poor sight but has a high sense of smell. Use of non-palatable crops like castor and safflower can minimize wild boar entry.

High density planting of castor with spacing of 45 cm between rows x 30 cm between plants surrounding maize field, or safflower planted at 30 x 15 cm spacing surrounding groundnut field has proved very effective in preventing wild boar entry.

Performance

This eco-friendly technique reduced damage to an extent of 70-85% and gave an additional income to the farmer through barrier crops.

Cost of Technology

Additional seed cost for castor (Rs.50/acre) and safflower (Rs.30/acre).

Impact and Benefit

It is eco-friendly in nature and reduces damage to a greater extent and increases yield by 15-20%. It fetches an additional income to the farmer through sale of barrier crops. This method also attracts pollinators apart from increasing castor and safflower area in the region.

Castor as Barrier Crop in Maize

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Preventing Damage from Wild Boars in Crops Using Bioacoustics

Protecting Groundnut using Bioacoustics

Salient Features

The concept of acoustics is the latest promising technology for scaring higher vertebrates from crop fields. Technology of Bio-acoustic gadget to reduce Wild boar damage in crops uses predatory, distress and alarm calls of various animals that convey 'danger' message to the wild animals invading crop fields. The equipment works both with normal electricity and solar power. The calls are broadcast in a field by using an electronic platform with sound drives.

Performance

The equipment effectively covers an area of 8-15 acres when ambient noise level stays around 42 db (decibels). Bioacoustics is effective in dispersing up to 92% of wild boar from the cropped area.

Cost of Technology

The assembled gadget costs around Rs.20,000/unit.

Impact and Benefit

This acoustic equipment has been demonstrated at 152 locations in Telangana and has proved effective. It saves manpower and reduces losses due to wild boar damage. Enhancement of yields is 50-74% than fields without any wild boars control.

Wild Boar

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Technology to Prevent Bird Damage in Aquaculture Farms

Spreading of Fishnet around the Bund

Erecting of wire around the Fish Pond

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Salient Features

A total of 72 species of birds were identified in and around aquaculture farms. Only 11 were identified as key bird species causing damage to fish at different growth stages. The extent of damage during seedling stage varied from 8 to 16% and during harvesting stage from 15 to 22%.

Performance

Spreading fish net of ±90 cm width from the bund to the fixed poles around the pond reduced the damage to fish by 60-70% during seedling and harvesting stages.

Erecting of GI wire around the farm pond in three rows at a slant position using bamboo sticks with first row at distance of 25 cm closer to the bund and fixing subsequent rows at 130 cm apart, reduced the damage to fish by 55-78% during seedling and harvesting stages.

Erecting reflective ribbon in North to South direction at 0.5m height above water level at 2 to 3m intervals using bamboo poles around the farm pond reduced the damage to fish by 70-80% during all growth stages of fish.

Cost of Technology

Cost involved in spreading of fish net around the farm is approximately Rs.5000/acre.

Cost of fixing of GI wire around the fish farm is approximately Rs.1400/acre.

Cost of fixing of reflective ribbon around the fish farm is approximately Rs.800/acre.

Impact and Benefit

All the three technologies are cost effective, save man power costs and reduce fish losses by piscivorous birds.

These methods are effective in all seasons and enhance fish yield from aquaculture farms by 15-25%.

Tractor Operated Ananta Groundnut Planter cum Boom Sprayer

Salient Features

Ananta groundnut planter cum boom sprayer is developed to perform two functions simultaneously *viz.*, spray application of herbicide along with sowing of seeds. It is provided with two seed boxes of 40 kg capacity each and an inclined plate metering mechanism to sow seeds and two drums of each 220 litres capacity, piston type pump for developing the sufficient pressure, four flat fan nozzles arranged at the back of planter on the boom to spray the chemical uniformly after the furrow is closed by the planter blade. Nozzle to nozzle spacing on boom is 60 cm; boom height from ground is 60 cm and it has a 1.5-2.0 hp pump.

Performance

Application rate	: 495 liters/ha
Power requirement	: 35 hp and above tractor
Effective working width of boom spray	: 240 cm
Field operating capacity	: 0.6 ha/h
Seed rate sown	: 100 kg/ha
Speed of operation	: 2.5 kmph

Cost of Technology

The cost of this implement is Rs. 95000.

Impact and Benefit

There is an increase in groundnut pod yield by 20 to 30% and net saving is Rs. 446/ha when compared to traditional method of manual sowing and spraying.

Contact
Principal Scientist (Agril. Engineering & Head)
AICRP on FIM, ARI, Rajendranagar
Hyderabad-500030, Telangana State
Phone: 040-24018277
E-mail: fimscheme@gmail.com

Four-Wheel Drive Tractor (22 Hp) Mounted 8-Row Paddy Transplanter

Salient Features

The 4-wheel drive 22 hp mini tractor provides power for propulsion and for working of the paddy transplanting unit. The machine consists of 4-wheel drive tractor along with rubber reinforced metallic wheels, a reduction gear box, float, 8-row transplanting unit with three points linkage, seedling tray and other associated components.

Performance

Forward speed	1st gear	2nd gear	3rd gear
Operating speed (kmph)	1.87	2.09	2.5
Field operation capacity (ha)	0.188	0.24	0.288
Field efficiency (%)	53	60	61
Fuel consumption (l/h)	1.2	1.0	0.9

	Hill to hill spacing, cm	Missing hills, %
PTO 1 & Gear 1	10	6.7
PTO 1 & Gear 2	15	7.04
PTO 2 & Gear 2	10	6.94

The machine cost of operation is Rs. 1919/ha when operated at 2nd gear whereas the cost of operation is Rs. 3750/ha with conventional method.

Cost of Technology

Cost of implement is Rs. 2,00,000.

Impact and Benefit

Net saving is Rs. 1831/ha when compared to traditional method

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Stem Applicator cum Weeder for Cotton Crop

Salient Features

Stem applicator cum weeder can be used for application of chemical to cotton stems for the control of sucking pests and for weeding simultaneously.

Weight (including the tank) : 67 kg
Tank capacity : 10 l

Performance

Application rate of chemical : 25 l/ha
Field efficiency : 84 %
Field operation capacity : 0.058 ha/h
Fuel consumption : 1.2 l/h
Width of operation : 56 cm
Depth of operation : 6 cm
Speed of operation : 1.2 kmph
Weeding efficiency : 80 %

Cost of Technology

Cost of implement is Rs. 85000/-

Impact and Benefit

The saving in cost is Rs. 1020/hour compared to manual operation.

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Power Operated 8-Row Drum Seeder cum 4-Row Weeder for Paddy

Salient Features

The weight of this machine is 30 kg. The diameter of the seed metering hole 9 mm with nine seed metering holes per drum. The machine has 24 weeder blades.

Performance

Field operation capacity of drum seeder	: 0.168 ha/h
Seed rate sown	: 40.4 kg/ha
Field operation capacity of weeder	: 0.096 ha/h
Field efficiency of weeder	: 71 %
Operating speed of weeder	: 1.69 kmph
Fuel consumption	: 1.2 l/h
Weeding efficiency	: 73 %

Cost of Technology

Cost of implement is Rs.60000.

Impact and Benefit

It saves man power and reduces human drudgery and cost of operation.

Contact
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Three-Row Power Weeder for Rice

Salient Features

Three-row power weeder can be used for weeding operation in 20, 25 or 30 cm row spacing in rice crop. The overall dimensions are: 1250 cm in length, 810 cm and 820 cm in height. It has a total weight of 18 kg.

Performance

At an operating speed of 1.6 kmph

and at a hill spacing in field	20 cm	25 cm	30 cm
Field operating capacity (ha/h)	0.07	0.085	0.10
Field efficiency (%)	72.9	70.83	71.42
The highest weeding efficiency (%)	82	79	77

The operation capacity and efficiency is increased as spacing between row is increased.

Cost of Technology

Cost of implement is Rs.85000

Impact and Benefit

Power weeder can be used satisfactorily in direct sowing by drum seeded or machine or manual transplanted crop. It is easy to handle and transport due to its light weight.

Contact
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Tractor Drawn Turmeric Digger

Salient Features

Turmeric digger is used to dig turmeric rhizomes lying at depth ranging from 300 to 350 mm in soil. It consists of a blade (size 1450 mm) and a frame is provided for adding an additional dead weight (up to 150 kg) for easy digging. Blade has a rake angle of 55° and weighs 200 kg. Only one person is required to operate.

Performance

Field efficiency	: 98%
Field operation capacity	: 0.3 ha/h
Power requirement	: 45 hp and above tractor
Speed of operation	: 2.5 kmph
Fuel consumption	: 5 l/h
Depth of harvest	: 300-350mm

Cost of Technology

Total cost of the implement is Rs.30000.

Impact and Benefit

Saves man power and reduces losses due to mechanical damage and drudgery. The net saving is Rs. 4200/ha when compared to manual digging of turmeric tubers.

Contact
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Selective Mechanization in *Kharif* Castor

Intercultivation with rotavator fitted to mini tractor

Threshing by mechanical castor thresher

Contact
The Associate Director of Research
Regional Agril. Res. Station, Palem-509215
Nagarkurnool district. Telangana State
Phone: 08540-228646
E-mail: adr_palem@rediffmail.com

Salient Features

Castor is predominantly cultivated by bullock drawn implements and manual methods. Selective mechanization can help save labour and time besides increasing the seed yield and net return to farmers.

Performance

About 55 hours and 23 labourers can be saved through selective mechanization as compared to traditional method. Additionally 13% higher yield and an additional net income of Rs.9448/ha can be obtained through selective mechanization. Rotavator can cover one acre in 2 hours while mechanical thresher has a capacity of 5-6 q/hour.

Cost of Technology

Cost of Conventional method is Rs.27320/ha. Selective mechanization will cost Rs.23945/ha. Rotavators (Rs.50000) and castor threshers (Rs.1,20,000) are available in the market and are also available on hire basis in some of the villages. The hiring charges for castor thresher is Rs.3000/ha and for rotavator Rs. 600/hour.

Impact and Benefit

Timely field operations are possible with this technology. It will reduce drudgery in field operation and improve the yield and returns to farmers.

ANNEXURE

List of Technologies Developed from Southern Telangana Zone

S.No	Technology	Research Station and Scientists Contributed
1	Agromet Advisory Services to Address Weather Variability	**Agro Climate Research Centre (ACRC), Rajendranagar** Dr. G. Sreenivas, Dr. D. Raji Reddy, Sri. S.G. Mahadevappa, Dr. S. B. S. Narsimha Rao, Dr. A. Madavi Lata, Dr. K. Vijayalaxmi, Dr. B. Balaji Naik
2	Sowing Rule to Adjust to Climate Variability in Rainfed Area	**Agro Climate Research Centre (ACRC), Rajendranagar** Dr. D. Raji Reddy, Dr. G. Sreenivas, Sri. S.G. Mahadevappa
3	Use of Planting Windows to Produce Quality Hybrid Seed	**SRTC, Rajendranagar** Dr. K. Kanaka Durga,Dr. M. R. Sudharshan, Dr. A.V.V. Reddy
4	Early Sowing with High Yielding Variety to Improve Seed Yield and Oil Content in Rainfed Safflower	**ARS, Tandur** Dr. C. Sudhakar, Dr. C. Sudha Rani, Sri. T. Rajeshwar Reddy
5	Modifying Atmosphere in Storage Area to Prevent Seed Borne Pests and Diseases	**SRTC, Rajendranagar, Hyderabad** Dr.V. Bharathi, Dr. R. Sudhakar, Dr. Bharathi N. Bhat, Dr. M. Rajasri, Dr. C. Srinivas, Dr. A. Padmasri, Dr. K. Parimala, Dr. A.V.V. Reddy, Dr. N.V. Naidu, Dr. T. Pradeep
6	Use of Desiccant Beads for Seed Storage	**SRTC, Rajendranagar** Dr. M. Sudharani, Dr. V. Bharathi, Dr. C. Srininvas, Dr. K. Kanaka Durga, Dr. A. Padmasri, Dr. A.V.V. Reddy, Dr. N.V. Naidu
7	A Novel Technique to Increase Productivity of Redgram by Transplanting	**ARS, Tandur** Dr. C. Sudha Rani, Dr. C. Sudhakar, Dr. C.V. Sameer Kumar
8	Square Planting in Redgram	**ARS, Tandur** Dr. C. Sudha Rani, Dr. C. Sudhakar, Sri. T. Rajeshwar Reddy
9	Alternate Wet and Dry (AWD) Management in Rice	**WTC, Rajendranagar** Dr. V.Ramulu, Dr. K. Avil Kumar, Dr. V.Praveen Rao

List of Technologies Developed from Southern Telangana Zone

S.No	Technology	Research Station and Scientists Contributed
10	Farm Pond Technology for Rainfed Crops	**RARS, Palem** Dr. A.V. Ramanjaneyulu, Dr. A. Madhavi, Dr. T.L. Neelima, Dr. K. Dharma Reddy
11	Drip Irrigation Regimes and Fertigation Schedules in *Rabi* Sorghum	**WTC, Rajendranagar** Dr. K. Avil Kumar, Dr. V.Ramulu, Dr. M.Uma Devi
12	Yield Enhancement and Water Saving through Micro-Irrigation in *Rabi* Groundnut	**RARS, Palem** Dr.A.V. Ramanjaneyulu, Dr. V. Ramulu, Dr A. Srinivas, Dr. M. Venkata Ramana
13	Integrated Nutrient Supply for Rice-Rice Sequence Cropping	**AICRP-IFS, Rajendranagar** Dr. M.V. Ramana, Dr. S.Sridevi, Dr. K.Suresh, Dr. M.Goverdhan
14	Balanced Fertilization for Sustainable Soil and Crop Productivity in Rice-Rice Cropping Sequence	**AICRP-IFS, Rajendranagar** Dr. Md. Latheef Pasha, Dr. S.Sridevi, Dr. M.V.Ramana, Dr. P.Raghu Rami Reddy, Dr. M.Goverdhan, Dr. M.Malla Reddy, Dr. E.Srinivas, Dr. P.Leela Rani
15	P-Fertilizer Saving in High P Soils for Maize and Rice	**RTL, Rajendranagar** Dr. P. Surendra Babu, Dr. A. Madhavi, Dr. P.Venkat Reddy,
16	Cost Reduction on Zinc Fertilizer by Increasing Its Use Efficiency	**AICRP on Micronutrients, Rajendranagar** Dr. P.Surendra Babu, Dr. G. Bhupal Raj, Dr. M. Chandni Patnaik, Sri. K. M. Khadke, Dr. M. Shankaraiah
17	Fortification of Fodder Maize with Zinc	**AICRP on Forage crops, Rajendranagar** Dr. M. Shanti, Dr. T. Shashikala, Dr. R. Susheela
18	Soil Test Based Prescription Equations for Balanced Fertilizer Use and Targeted Yield of *Rabi* Castor in Light Soils	**AICRP on STCR, Rajendranagar** Dr. A.Madhavi, Dr. K.Rajamani, Dr. T.Srijaya, Dr. D.V. Ramana Reddy
19	Efficacy of Herbicides in Direct Seeded Rice	**AICRP on Weed management, Rajendranagar** Dr. M. Madhavi, Dr. A. Srinivas, Dr. T. Ramprakash

List of Technologies Developed from Southern Telangana Zone

S.No	Technology	Research Station and Scientists Contributed
20	New Post-Emergence Herbicides for Weed Management In Maize	**AICRP on Weed Management, Rajendranagar** Dr. M. Madhavi , Dr. D. Sreelatha, Dr. T. Ramprakash, Dr. V. Swarnalatha
21	Ideal Management Practices for *Rabi* Castor	**RARS, Palem** Dr. A.V. Ramanjaneyulu, Dr. M.V. Nagesh Kumar, Dr. A. Madhavl, Dr. T.L. Neelima, Dr. K. Dharma Reddy
22	Best Management Practices for Yield Maximization in Rainfed Safflower	**ARS, Tandur** Dr. C. Sudhakar, Dr. C. Sudha Rani, Sri. T. Rajeshwar Reddy,
23	Efficient Cropping Systems for Southern Telangana	**AICRP-IFS, Rajendranagar** Dr. M.V. Ramana, Dr. S. Sridevi, Dr. M.Goverdhan
24	Diversification of Rice-Rice Cropping Systems in Southern Telangana	**AICRP-IFS, Rajendranagar** Dr. M.V. Ramana, Dr. S. Sridevi, Dr. M.Goverdhan
25	Bio Intensive Complimentary Cropping Systems for Southern Telangana	**AICRP-IFS, Rajendranagar** Dr. K. Suresh, Dr. S. Sridevi, Dr. M.V. Ramana, Smt. Ch. Pragathi Kumari, Dr. M. Goverdhan
26	Field Crop, Horticulture and Livestock Integrated Farming System for Southern Telangana	**AICRP-IFS, Rajendranagar** Dr. M.V. Ramana, Dr. S. Sridevi, Dr. K. Suresh, Dr. M. Goverdhan, Smt. Ch. Pragathi Kumari
27	Diversification of Farming Systems for Doubling the Farm Income	**AICRP-IFS, Rajendranagar** Dr. Md. Latheef Pasha, Dr. S. Sridevi, Dr. M.V.Ramana, Dr. P.Raghu Rami Reddy, Dr. M.Goverdhan, Dr. M.Malla Reddy, Dr. E. Srinivas , Dr. P. Leela Rani
28	Improvement of Farming Systems for Enhanced Profitability and Livelihood of Small Farmers	**AICRP-IFS, Rajendranagar** Dr. Md. Latheef Pasha, Dr. M.V.Ramana, Dr. S.Sridevi, Dr. P.Raghu Rami Reddy, Dr. M.Goverdhan, Dr. M.Malla Reddy, Dr. E.Srinivas, Dr. P.Leela Rani
29	Profitable *Melia dubia* Based Silvi-Pastoral System for Rainfed Marginal Lands	**AICRP on Agro-Forestry, Rajendranagar** Dr. M. A. Ariff Khan, Dr. A. Krishna

List of Technologies Developed from Southern Telangana Zone

S.No	Technology	Research Station and Scientists Contributed
30	Hydroponic Fodder Production Technology for Dairy Farmers	**AICRP on Forage crops, Rajendranagar** Dr. M.Shanti, Dr. T.Shashikala
31	Sweet Sorghum - The New High Yielding Nutritive Fodder Crop	**AICRP on Forage crops, Rajendranagar** Dr. M. Shanti, Dr. T. Shashikala, Dr. R. Susheela
32	Safflower Herbal Tea for Increasing Farmers Income in Rainfed Areas	**ARS, Tandur** Dr. C. Sudhakar, Dr. P. Anil Kumar, Dr. C. Sudha Rani, Dr. C.V. Sameer Kumar, Sri. T. Rajeshwar Reddy, Dr. M. Suresh
33	Silage Preparation in Polythene Bags	**AICRP on Forage crops, Rajendranagar** Dr. M.Shanti, Dr. T.Shashikala
34	Services for Testing and Certification on Quality of Food Products	**Quality Control Laboratory, Rajendranagar** Dr. M. Sreedhar, Dr. K.Aparna
35	Pesticide Residue Testing Services	**AINP on Pesticide Residue, Rajendranagar** Dr. V.Anitha, Dr. K.Kavitha, Dr. M.Aruna, Dr. B.Aparna, Dr. Swati Chakrabarthy, Mr. Kishore, Mr. Kishan Prasad
36	Novel Insecticide Molecule for Management of Rice Yellow Stem Borer	**Rice Research Centre, Rajendranagar** Dr. N. Rama Gopala Varma, Dr. S. Dayakar
37	Compatible Insecticides and Fungicides to Protect Rice Crop from Multiple Pests and Diseases	**Rice Research Centre, Rajendranagar** Dr. R. Jagadeeshwar, Dr.N. Rama Gopala Varma
38	Identification of Resistant Sources for Rice Panicle Mite, *Steneotarsonemus spinki*	**Rice Research Centre, Rajendranagar** Dr. N. Rama Gopala Varma, Dr. R. Jagadeeshwar, Dr.Ch. Surender Raju, Dr. L. Krishna, Dr. Ch. Damodar Raju, Dr. S. Vanisree, Dr. Y. Chandra Mohan
39	Chemical Control of Maize Stem Borer (*Chilo partellus*)	**MRC, Rajendranagar** Dr. M. Lava Kumar Reddy
40	New Insecticide for Management of Leafhopper in Castor	**RARS, Palem** Ms. N. Jemimah, Dr. M. Jyothsna, Dr. V. Ramya, Dr. M. V. Nagesh Kumar,

List of Technologies Developed from Southern Telangana Zone

S.No	Technology	Research Station and Scientists Contributed
41	New IPM Module for Castor	**RARS, Palem** Ms. N. Jemimah, Dr. M. Jyothsna, Dr. V. Ramya, Dr.M.V.Nagesh Kumar
42	Technology to Reduce Crop Damage from Peafowl	**AINP on Vertebrate Pest Management, Rajendranagar** Dr. V.Vasudeva Rao, Dr. V.Sunitha, Dr. V.Ravinder Reddy, Dr. P.Venkateswarlu
43	Reducing Crop Losses from Birds (Using Bioacoustics, Reflective Ribbons, Jute or Plastic Shade Nets)	**AINP on Vertebrate Pest Management, Rajendranagar** Dr. V.Vasudeva Rao, Dr. V.Sunitha, Dr. P.Venkateswarlu
44	Artificial Nest Box Design for Conservation of Insectivorous Birds	**AINP on Vertebrate Pest Management, Rajendranagar** Dr. V.Sunitha, Dr. V.Vasudeva Rao, Dr. V.Ravinder Reddy
45	Preventing Damage from Wild Boars in Crops (Using HDPE Nylon Net, Circular Blade Wire, Barrior Crops and Bioacoustics)	**AINP on Vertebrate Pest Management, Rajendranagar** Dr. V.Vasudeva Rao, Dr. V.Sunitha, Dr.V.Ravinder Reddy, Dr. P.Venkateswarlu, Sri. A.V. L. N. Ramalingeswara Rao
46	Technology to Prevent Bird Damage in Aquaculture Farms	**AINP on Vertebrate Pest Management, Rajendranagar** Dr. V.Vasudeva Rao, Dr. V. Ravinder Reddy, Sri. A.V.L.N. Ramalingeswara Rao
47	Tractor Operated Ananta Ground Nut Planter-Cum Boom Sprayer	**AICRP on FIM, Rajendranagar** Dr. G. Aravind Reddy, Dr. P. Sudhakar Reddy, Dr. Madhusudhan Reddy
48	Four-Wheel Drive Tractor (22 Hp) Mounted 8-Row Paddy Transplanter	**AICRP on FIM, Rajendranagar** Dr. G. Aravind Reddy, Dr. P. Sudhakar Reddy, Dr. B. Ashwin Kumar, Dr. R. Jaya Prakash
49	Stem Applicator Cum Weeder For Cotton Crop	**AICRP on FIM, Rajendranagar** Dr. G. Aravind Reddy, Dr. P. Sudhakar Reddy, Dr. B. Ashwin Kumar, Dr. R. Jaya Prakash
50	Power Operated 8-Row Drum Seeder Cum 4-Row Weeder for Paddy	**AICRP on FIM, Rajendranagar** Dr. G. Aravind Reddy, Dr. P. Sudhakar Reddy, Dr. B. Ashwin Kumar, Dr. R. Jaya Prakash,

List of Technologies Developed from Southern Telangana Zone

S.No	Technology	Research Station and Scientists Contributed
51	Three-Row Power Weeder for Rice	**AICRP on FIM, Rajendranagar** Dr. G. Aravind Reddy, Dr. P. Sudhakar Reddy Dr. B. Ashwin Kumar, Dr. R. Jaya Prakash
52	Tractor Drawn Turmeric Digger	**AICRP on FIM, Rajendranagar** Dr. G. Aravind Reddy, Dr. P. Sudhakar Reddy, Dr. Er. Swamy, Dr. Kalapana
53	Selective Mechanization in *Kharif* Castor	**RARS, Palem** Dr. A.V. Ramanjaneyulu, Dr. M.V. Nagesh Kumar, Dr. A. Madhavi, Dr. T.L. Neelima, Dr. D. Vishnuvardhan Reddy, Dr. A. Srinivas, Dr. M. Venkata Ramana

List of Technologies Developed from Central Telangana Zone

S.No	Technology	Research Station and Scientists Contributed
1	Bud Chip Technology in Sugarcane	**ARS, Basanthpur** Dr. M. Vijay Kumar, Dr. G. S. Madhu Bindu, Dr. M. Suresh, Dr. D. Vishnu Vardhan Reddy, Dr. C. Cheralu, Dr. P. Raghu Rami Reddy
2	Two-Row Sugarcane Planting on Widely Spaced Furrows for Mechanized and Drip Irrigated Cultivation	**ARS, Basanthpur** Dr. G.S. Madhu Bindu, Dr. M. Vijay Kumar, Dr. C. Cheralu, Dr. P. Raghu Rami Reddy
3	Chemical Weed Management in Greengram	**ARS, Madhira** Dr. S. Srinivasa Rao, Dr. V. Sridhar, Dr. D. Shivani, Dr. B. V. Varaprasad, Dr. P. Raghu Rami Reddy
4	High Density Planting System in Cotton for Rainfed Ecosystem	**RARS, Warangal** Dr. B. Ram Prasad, Sri. A. Sudarshanam, Dr. S. Malathi, Dr. P. Raghu Rami Reddy
5	Soil Moisture Conservation Techniques in Cotton	**RARS, Warangal** Dr. G. Veeranna, Sri. A. Sudarshanam, Dr. P. Raghu Rami Reddy
6	Defoliants as an Aid to Harvest of Greengram	**RARS, Warangal** Dr. G. Veeranna, Dr. B. Padmaja, Dr. P. Jaganmohan Rao, Dr. V. Thirumala Rao, Dr. B. Dileep Kumar, Dr. P. Raghu Rami Reddy
7	Optimum Time of Sowing in *Rabi* for Seed Production of *Sesbania*	**RARS, Warangal** Dr. G. Veeranna, Dr. M. Malla Reddy, Dr. C. Cheralu.
8	Novel Molecules to Manage Brown Planthoppers (BPH) in Rice	**RARS, Warangal** Dr. S. Malathi, Dr. A.Venkat Reddy, Dr. P. Raghu Rami Reddy
9	Compatible Acaricides and Fungicides to Protect Rice Panicle and Grains	**RARS, Warangal** Dr. A. Venkat Reddy, Dr. R. Sunitha Devi, Dr. S. Dhurua, Dr. N. R. G. Varma, Dr. S. Malathi, Dr. D. Vishnu Vardhan Reddy, Dr. C. Cheralu, Dr. P. Raghu Rami Reddy

List of Technologies Developed from Central Telangana Zone

S.No	Technology	Research Station and Scientists Contributed
10	Identification of New Sources as Donors for Resistance to Rice Gall Midge (Biotype 4M)	**RARS, Warangal** Dr. S. Malathi, Dr. A. Venkat Reddy, Dr. P. Raghu Rami Reddy
11	New Potential Sources for Use as Donors for Resistance to Rice Planthoppers	**RARS, Warangal** Dr. S. Malathi, Dr. A. Venkat Reddy, Dr. P. Raghu Rami Reddy
12	Novel Insecticide Molecules for Sucking Pest Management of Cotton through Stem Application	**RARS, Warangal** Dr. B. Ram Prasad, Sri. A. Sudarshanam, Dr. P. Raghu Rami Reddy
13	Compatible Combination of Insecticides to Control Sucking Pests in Cotton	**RARS, Warangal** Dr. B. Ram Prasad, Dr. S. Malathi, Sri. A. Sudarshanam, Dr. P. Raghu Rami Reddy
14	Integrated Pest Management in *Bt* Cotton	**RARS, Warangal** Dr. B. Ram Prasad, Sri. A. Sudharshanam, Dr. P. Raghu Rami Reddy
15	Creating Awareness on Insecticide Resistance Management (IRM) in Cotton	**RARS, Warangal** Dr. B. Ram Prasad, Sri. A. Sudarshanam, Dr. S. Malathi, Dr. P. Raghu Rami Reddy
16	Non-Chemical Management of Pulse Beetle in Stored Red gram	**RARS, Warangal** Dr. B. Dileep Kumar, Dr. P. Raghu Rami Reddy

List of Technologies Developed from Northern Telangana Zone

S.No	Technology	Research Station and Scientists Contributed
1	Importance of Planting Density in Maize	**ARS, Karimnagar** Dr. G. Manjulatha, Dr. E. Rajanikanth
2	Site Specific Nutrient Management in Maize	**ARS, Karimnagar** Dr. G. Manjulatha, Dr. E. Rajanikanth
3	De-topping to Increase Fodder Yield without Loss of Cob Yield in Maize	**ARS, Karimnagar** Dr. E. Rajanikanth, Dr. G. Manjulatha
4	Economizing Phosphorus Use in Groundnut through P Solubilising Bacteria	**RARS, Jagitial** Dr. P. Revathi, Dr. M. Venkataiah, Sri P. Gonya Nayak, Dr. K. Chandra Shekar
5	Preparation of Vermicompost Using Uprooted Cotton Stalks	**RARS, Jagitial** Dr. S. Laxman
6	Antibiotic Producing Fluorescent *Pseudomonas* for Increasing Yield and Control of Soil Borne Diseases in Groundnut	**RARS, Jagitial** Dr. P. Revathi, Dr. M. Venkataiah, Sri P. Gonya Nayak, Dr. T. Kiran Babu
7	Management Practices for Cold Injury in *Rabi* Rice Nurseries	**RS & RRS, Rudrur** Dr. T. Prabhakar Reddy, Sri. J. Kamalakar, Dr. Ch. Sambasiva Rao, Dr. N. Sandya Kishore
8	Suitable Sugarcane Varieties for Planting at Wider Spacing	**RS & RRS, Rudrur** Smt. Firdoz Sahana, Dr. U. Naga Bushanam, Dr. B. Joseph
9	Phosphorous Requirement and its Time of Application in Rice Grown on P Accumulated Soil	**RS & RRS, Rudrur** Dr. T. Prabhakar Reddy, Sri. J. Kamalakar, Smt. Firdoz Sahana
10	Rescheduling of Fertilizer Doses for Soybean in Northern Telangana	**RS & RRS, Rudrur** Dr. T. Prabhakar Reddy, Sri. J. Kamalakar, Dr. Ch. Sambasiva Rao, Dr. B. Joseph
11	Fertigation Schedule in Sugarcane	**RS & RRS, Rudrur** Dr. T. Prabhakar Reddy, Sri. J. Kamalakar, Dr. Ch. Sambasiva Rao, Dr. V. Ramulu
12	Rescheduling of Fertilizer Dosage for Sugarcane in Northern Telangana	**RS & RRS, Rudrur** Dr. T. Prabhakar Reddy, Sri. J. Kamalakar, Dr. Ch. Sambasiva Rao, Dr. B. Joseph