GROUNDNUT BASED TECHNOLOGIES FOR FARMERS

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TECHNOLOGY ASSESSMENT AND REFINEMENT THROUGH INSTITUTION - VILLAGE LINKAGE PROGRAMME (RTAR-12)

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PREFACE

The Technology Assessement and Refinement Through Institution Village-Linkage Programme (TAR-IVLP) was operative at the National Research Centre for Groundnut (NRCG), Junagadh under Agro-Ecosystem of National Agricultural Technology Project (NATP) since 1999 in four adopted villages viz; Vadhavi and Zanjarda of Junagadh taluka and Nandarkhi and Umatwada of the Vanthali taluka of Junagadh district in Saurashtra region of Gujarat State with about 1100 farm families as beneficiaries. The Core-Team Scientists and Technical staff executed the activities of TAR-IVLP timely and effectively. The project scientists and technical staff had very effective interactions with farmers for implementation of the programme.

During 1999-2004, a total of 19 technologies were assessed and validated in groundnut based production system on 605 farmers fields. Out of 19 technologies, 14 were under Natural Resource Managemnet (NRM), 3 were under Horticulture and 2 were under Animal Husbandry. In addition, 7 training programmes, 3 for farmers (1. IPM, 2. INM and 3. Water management in grounndut based cropping system), 3 for farm women (preparation and preservation of fruits and vegetable products (two times) and preparation of groundnut based bakery items) and one for Scientist working under TAR-IVLP project were organized during the period under report.

After 6 years, 11 groundnut-based technologies useful for farmers emerged from TAR-IVLP project, which could be transferred to farmers for wider adoption. The intervention of project-scientists with the farmers in major areas such as Integrated Nutrient Management (INM), Integrated Pests Management (IPM), Groundnut based cropping system, Deep tillage technology and Animal nutrition, resulted in increased adoption of technologies in the target villages.

The guidance received from Director, Agro-Ecosystem (Rainfed), Co-ordinator (TAR-IVLP), CRIDA, Hyderabad and Dr. A. Bandyopadhyay, the then Director, NRCG, Junagadh and the cooperation of project scientists and farmers in assessing of technologies significantly contributed to the success of the TAR-IVLP programme during 1999-2004. I wish to place on record the support and encouragement received from Dr. M. S. Basu, Director, NRCG, for successful completion of the project activities.

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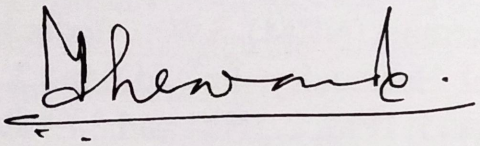

Junagadh
April, 2005

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CONTENTS

Groundnut based Technologies for Farmers

I. Introduction

The improvements in agriculture technologies have contributed to increased production and productivity at research level and to some extent at farm level. However, it appears from the socio-economic surveys that this has not reflected in raising the income and prosperity of the farmers in general and farmers belonging to the small production system in particular. The non-adoption of improved technologies by small and resource poor farmers was attributed to the inappropriateness of these technologies to them. Hence, there was an urgent need for a critical assessment, refinement of technologies and development of relevant and acceptable technologies for better adoption by resource poor farmers.

This initiative was taken under National Agricultural Technology Project (NATP) by launching Technology Assessment and Refinement (TAR) through Institute-Village Linkage Programme (IVLP) for addressing the critical issues of assessment and refinement of technologies through farmer's participation. The TAR-IVLP project activities related to groundnut based technologies suiting to the requirements of farmers were implemented during 1999-2004 in four villages of Junagadh district of Gujarat state by National Research Centre for Groundnut (NRCG), Junagadh. Groundnut based technologies assessed and refined on farmers fields will ultimately help in improving socio-economic status of farm families at large.

II. Site characterization

The villages fall in South Saurashtra zone of Gujarat and are located in close proximity of NRCG (within 20 km) to enable close and frequent monitoring by the scientists. The landscape of the area is generally flat. The soils are medium-black and shallow to medium, with depths ranging from 15 to 30 cm. The climate of

The area is semi-arid with an average rainfall ranging from 550 mm to 750 mm. The rainfall is highly erratic and more than 90 per cent of the rain is received during June to September with several intermittent long dry spells. The monsoon rains generally commence by the third week of June but sometimes is delayed till the end of July. The winter showers are meager and rare. The drought is a rule rather than an exception for the area.

The major crops during rainy (kharif) season are: groundnut, castor and cotton. In post rainy season (rabi), wheat is the main crop. The groundnut + castor intercropping system has been prevalent in all the four villages. Livestock in these villages consists mainly of cows, buffaloes, bulls and goats.

III. Methodology

A preliminary survey of 24 villages was carried out and four villages namely Vadhavi, Zanjarda, Nandarkhi and Umatwada were selected based on the criteria laid down by the ICAR for the TAR-IVLP project. The Scientists of National Research Centre for Groundnut (NRCG) and Junagadh Agricultural University (JAU) carried out an in-depth analysis of the farming situation through Participatory Rural Appraisal techniques in these four villages. A total of 19 farmer participatory technologies in 605 farmers fields were assessed during 1999-2004. For each intervention,15-25 farmers were selected for conducting the trials. Each farmer was guided to layout 1000 m^2 area under the improved practice and the rest of the field was cultivated according to his conventional practice. The idea was to provide an opportunity for the farmers to assess and compare the improved practice with that of their own practice.

IV. Major constraints for agricultural production

The PRA exercise with farmers indicated the major constraints for agricultural production as follows

- Monocropping of groundnut
- Low yield of crops especially groundnut and wheat

- Prevalence of major soil borne diseases and insect pests
- Inefficient nutrient management
- Low milk production of cattle due to non-availability of fodder during lean period

About 60% of the farmers in the area grow groundnut during the rainy season by adopting a set-furrow method with a wider row spacing of 90 cm, very thick (2-5 cm plant -to- plant) planting and high seed rate (140-160 kg/ha) which result in increased inter-plant competition for light, nutrients and moisture. This inter plant competition ultimately results in low pod yield of groundnut. Moreover, the space of 90 cm between the rows invites more weed to grow, thereby, increasing the need for frequent intercultural operations. The monocropping of groundnut results in the buildup of soil borne diseases and risk of crop failure at the time of drought. Also, little care is taken to manage the soil borne diseases in groundnut. Improper nutrient management and shallow tillage result in low yield of groundnut.

Wheat is a major crop during the rabi season in the project area. Mostly local variety (Lok-1) is grown. The average yield of wheat in the area is 25-30 q/ha, which is lower than the average yield of 40-45q/ha Obtained in other parts of the country. The lower yield is mostly due to wider spacing (45 cm row-to-row). The wider spacing results in sub- optimal plant population and hence, low yield.

V. Technology interventions for solving the problems

1. Efficient Nutrient Management in Groundnut + pigeon pea intercropping

The groundnut+pigeon pea intercropping was introduced in the area by NRCG during 1999-2001. It was to avoid the crop failure due to frequent drought and also break the build up of soil borne diseases. The system was a great success and farmers adopted it on a large scale. However, the nutrient management system was

not efficient and farmers were applying imbalanced fertilizers to this intercropping system. Based on the research findings on efficient nutrient management, integrated nutrient management was introduced. It includes simply application of recommended NPK (12.5 : 25 : 20 kg/ha) through ammonium sulphate, single super phosphate, and muriate of potash, and phosphorus solubalizing microorganism (PSM) @ 500 g/ha as soil application instead of farmers practice (application of DAP only). The INM gave 35 % higher gross monetary returns and CBR of 1:2.78 compared with CBR of 1:2.72 in the farmers' practice (Fig. 1). Farmers were convinced with the benefits of this intercropping system. Farmers of even near by villages have started intercropping of pigeon pea with groundnut. Pigeon pea not only gives additional monetary benefit but also ensures fodder security. It may be mentioned here that before introducing this intercropping system in the project area through the intervention of IVLP, there was not a single farmer adopting this intercropping system. However, now adoption level by the farmers has gone up to the extent of 75 % in different IVLP villages and it is 44% in near by villages.

Bumper crop of pigeon pea after the harvest of groundnut

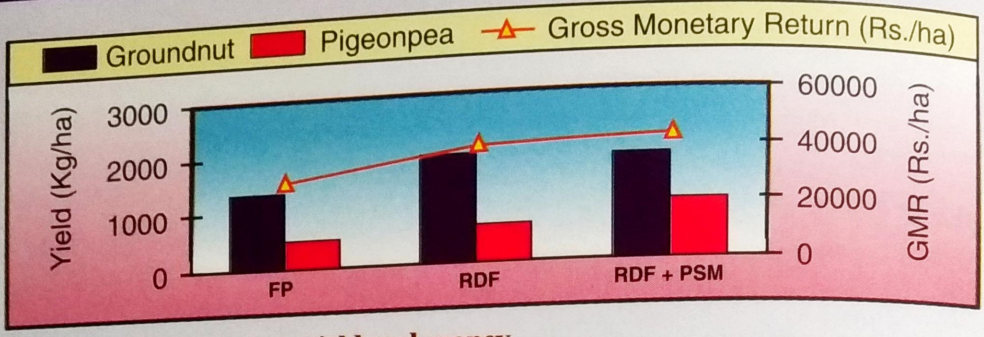


Fig. 1: INM gives more yield and money
FP - Farmers' practice, **RDF**-Recommended dose of fertilizer, **PSM** - Phosphorus solubalizing microorganism, **GMR** - Gross monetary returns

2. Management of insect pests and diseases in groundnut intercropping - The IPM way

In order to address the pest problem in the intercropping system, the concept of IPM was introduced. The IPM included simple components like seed treatment with carbendazim @ 2g/kg seed, soil application of castor cake @ 500 kg/ha, foliar spray of crude neem oil 2%, installation of pheromone trap @10/ha and pigeon pea as a trap crop. These components were developed at NRCG over the years and integrated into a module. Based on the initial experience of farmers, the trap crop of pigeon pea was replaced by castor. The results of 3 years (1999-2001) were very much encouraging to the farmers. They observed that IPM reduced the incidence of major diseases viz; collar rot by 40 %, stem rot by 52 %, early leaf spot by 41 %, late leaf spot by 44 %, rust by 41 %, aflaroot by 26 %, and Peanut bud necrosis disease (PBND) by 39 %. It also reduced the incidence of insects pests viz; thrips by 40%, jassids by 29% and defoliators by 34 % over their own practice. The IPM also generated additional income from castor/pigeon pea. Farmers obtained gross monetary returns of Rs. 53658/ha with ICBR of 6.19 with IPM as against their own practice (Rs 39826) (Fig. 2).

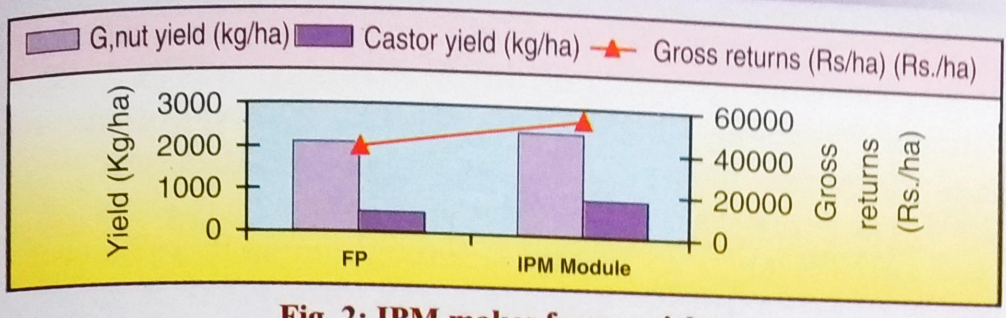


Fig. 2: IPM makes farmer richer

3. Optimum seed rate for higher yields

Maintaining optimum plant population is key factor for realizing higher yield. Use of recommended seed rate along with proper method of sowing and quality seeds ensure optimum plant stand. In general, the farmers adopt higher seed rate than the recommended in the region. A very simple intervention of optimum seed rate of 120 kg/ha in bunch variety and 100 kg/ha in spreading variety in kharif groundnut increased the pod yield of groundnut by 54 % over the farmers practice (seed rate of 140-160 kg/ha). The gross monetary return was Rs. 47029/ha with CBR of 1:2.88 due to optimum seed rate and in farmer's practice it was (Rs. 38467/ha)(Fig. 3).

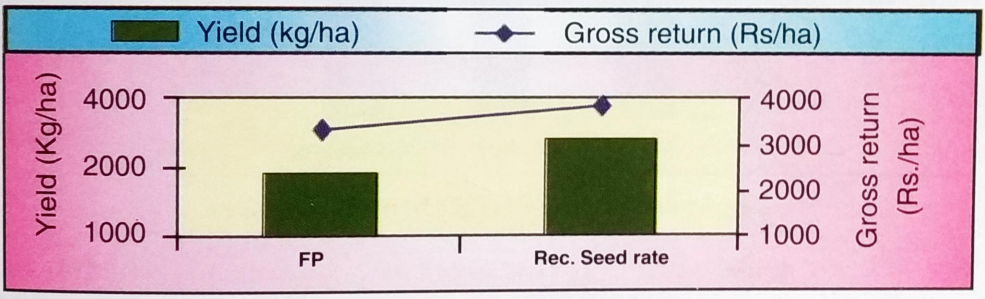


Fig. 3: Optimum seed rate maximum returns

4. PGPR-A new biofertilizer for higher productivity

Age-old practice of inoculation of rhizobium benefits groundnut by fixing atmospheric nitrogen. However, the new biofertilizer "Plant Growth Promoting Rhizobacteria (PGPR)", a combination of beneficial rhizophere microbes, provides benefits to plants by mobilizing majority of macro and micro nutrients, besides

producing hormones and thus improves crop yield. Based on highly encouraging results of this biofertilizer, at NRCG Plant Growth Promoting Rhizobacteria (PGPR) @ 500 g/ha as soil application was introduced in the farmers fields during 2002-2004. The PGPR was applied in the soil along with recommended dose of NPK (12.5:25:20 kg/ha) through ammonium sulphate, single super phosphate, and muriate of potash. This practice increased the pod yield by 44% over farmers practice (application of N and P through DAP). The farmers also observed that application of recommended NPK along with plant growth promoting rizobacteria gave higher yield of groundnut (2584kg/ha) as compared to their own practice (1795kg/ha). The gross monetary return was also higher (Rs.52418/ha) with CBR of 1:3.50 in recommended dose of NPK along with Plant Growth Promoting Rhizobacteria than the farmers practice, Rs. 43187/ha (Fig. 4).

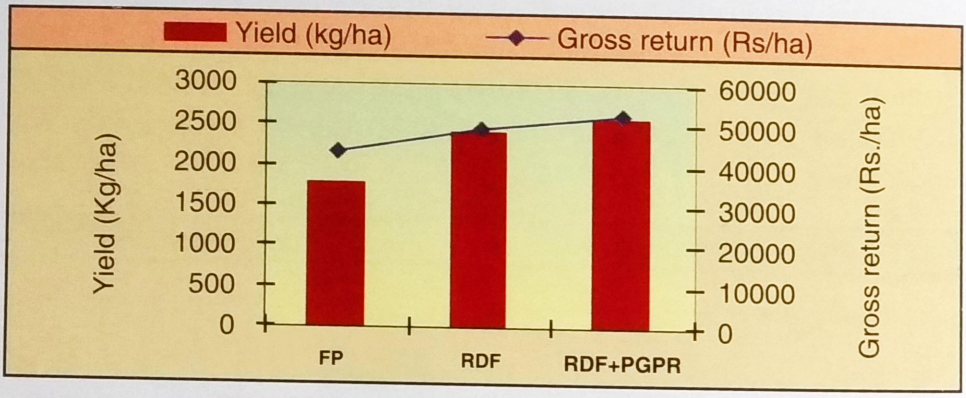


Fig.4 : Microbes (PGPR) benefits farmers

5. Castor cake -Boon to farmers for managing soil borne diseases

Among seed and seedling diseases, collar rot and stem rot are economically important diseases in groundnut. These diseases cause severe seedling mortality resulting in 'patchy' crop stand and reduce pod yield by 25 to 40%. These diseases appear in severe proportions in the project area. Farmers follow monocropping of groundnut in medium black soil adopting the set furrow system. Crop rotation is also not followed. Farmers do not adopt any

control measures against the stem rot and collar rot diseases. As a result inoculum of these diseases is getting build up in the soil every year. Therefore, it was thought fit to take up a separate programme on the management of these diseases using readily available castor cake as soil amendment. The soil application of castor cake @ 1000 kg/ha in furrow at the time of sowing was tried in 25 farmers fields in four villages of Junagadh district during rainy seasons of 1999. Though the effectiveness in controlling soil borne diseases due to application of castor cake was highly convincing, it was not economical mainly due to higher rate of applications. Therefore, refinement was done and soil application of castor cake @ 500 kg/ha was tried in 50 farmers fields in four villages during rainy seasons of 2000 and 2001 which was acceptable to farmers due to economics point of view and desirable level of control of these diseases. The farmers observed that seed treatment with Mancozeb (Dithane M 45) @ 3g/kg seed /Carbendazim (Bavistin) @ 2 g/kg seed one week before sowing and soil application of castor cake @ 500kg/ha at the time of sowing reduced the incidence of collar rot and stem rot by 64 and 55% respectively with increase in groundnut yield by 32% and gross monetary return by 30%. Farmers in the project area are adopting the application of castor cake for control of diseases and the practice is spreading to nearby villages (Fig. 5a & b).

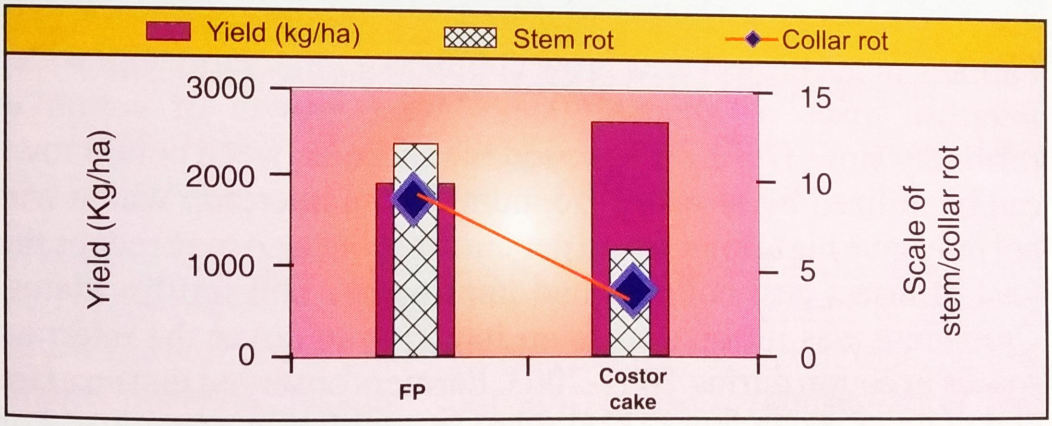


Fig. 5a: castor cake reduces diseases and increases yield of groundnut

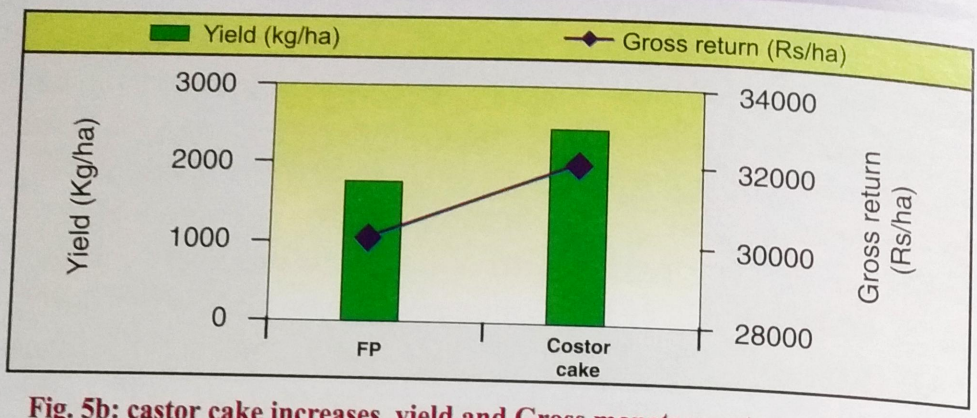
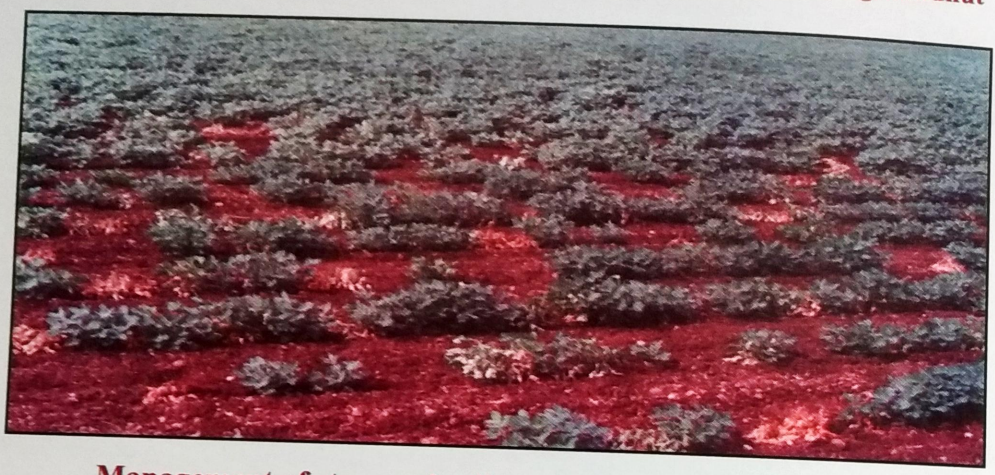


Fig. 5b: castor cake increases yield and Gross monetary return of groundnut



Management of stem and collar rots using castor cake (up), Severe incidence of collar and stem rots in farmers' practice (down)

6. Intercropping groundnut with cotton : Highly profitable system

Farmers in the project area grow cotton as a monocrop with wider interrow space of about 180cm. Initial growth of cotton is relatively slow. During this period the space between cotton rows can be utilized by growing groundnut as an intercrop which will not only give higher net return per unit area but also may reduce the load of insect pest build up and improve the soil fertility status. Groundnut was introduced as an intercrop to cover the interrow spaces in cotton during 2001-2003. Farmers observed that an extra pod yield of groundnut (2316kg/ha) in addition to cotton yield of 1576 kg/ha in the cotton + groundnut intercropping (1:2) was

obtained as compared to 1857 kg/ha in the farmers practice (sole cotton). Gross monetary return was higher (Rs.75188 /ha) in the intercropping system with CBR of 1:4.01 while in farmers'own practice of sole cotton, it was Rs. 41212/ha with CBR of 1:2.41 (Fig. 6).

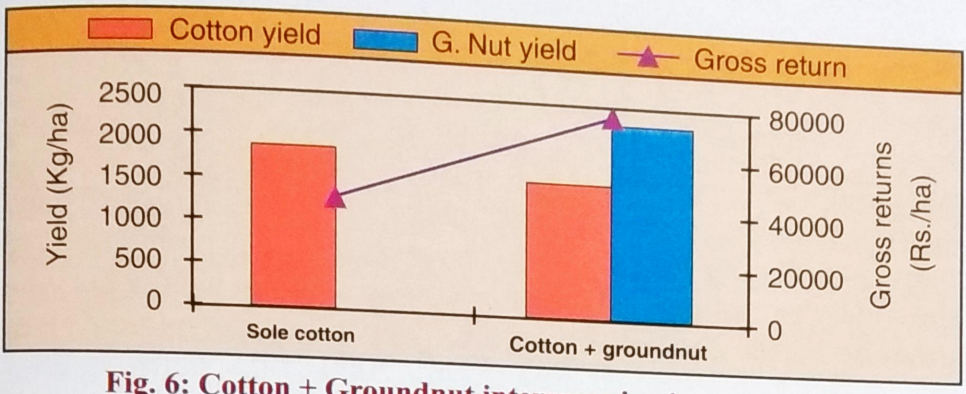


Fig. 6: Cotton + Groundnut intercropping increases yield

Optimum use of interrow space in cotton with groundnut

7. Deep tillage technology : A milestone in groundnut cultivation

While discussing with farmers, it was revealed that shallow tillage was preferred by the farmers mainly due to presence of hardpan below the soil depth (30 to 60 cm). It was observed that shallow tillage provides less in- situ soil moisture conservation and unsatisfactory soil physical conditions, which result in poor crop growth and low yield of groundnut. Also, the incidence of stem

Rot, collar rot and the perennial weeds increase due to shallow tillage. The practice of deep tillage in groundnut contributes to increase in yield as it results in deepening the active cultivation layer and improves physical properties of soil in the rhizophere. Therefore, water-holding capacity in the soil improves and infiltration rate increases. It improves the soil conditions for soil micro fauna also. Further, deep tilled soil facilitates the development of plant roots. Deep ploughing (20-25 cm) helps in breaking up of the hardpans formed over many years by shallow ploughing or prevents the formation of hard pans, thereby enabling more efficient nutrient uptake. In addition, deep tillage helps in reducing insect pupae, larvae and fungal populations in the soil by exposing them to the scorching summer heat or burying them deep into the soil.Therefore, deep tillage technology was introduced in the project area during 2000-2002. Farmers were convinced to adopt deep tillage instead of shallow tillage. They observed that there was reduction in the incidence of stem rot by 49% and collar rot by 71 % as compared to shallow tillage. Higher yield and less incidence of soil borne pathogens resulted in 24 % increase in gross monetary return over shallow tillage (Fig. 7). The highest gross monetary return of Rs. 39121/ha with CBR of 1:3.0 was also realized in deep tillage practice as compared to farmers own practice (Rs. 31516/ha with CBR of 2.54). The higher monetary return and less incidence of soil borne diseases strongly motivated the farmers of the project area to adopt deep tillage in place of shallow tillage for groundnut cultivation. Now the adoption level of this technology in the project area is 70% and in nearby villages it is to the extent of 27.9 %.

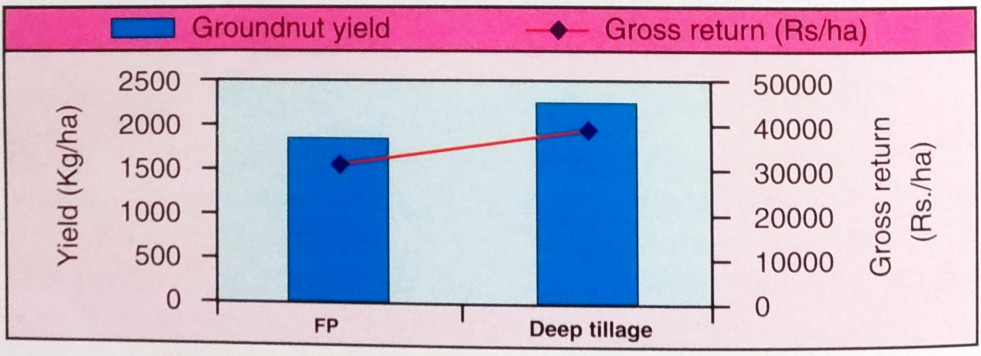


Fig. 7: Deep tillage gives higher yield and returns

8. Combating yellowing in rainfed groundnut

The majority of the soils of Saurashtra region are deficient in sulphur. Also, the availability of Fe(Iron) in the soil is restricted mainly due to high content of CO_3- and HCO_3- present in the soils. Deficiency of both, S and Fe in the soil causes yellowing in groundnut, and ultimately results in reduction of pod yield of groundnut by 10-20%. Farmers do not adopt any control measure of yellowing. Therefore, the technology of combating yellowing was demonstrated on farmers fields during 2000-2002. Farmers were motivated to adopt management of yellowing through soil application of elemental sulphur @ 20 kg/ha and two foliar sprays of 0.5% $FeSO_4$ with 0.2 % citric acid. Farmers observed that the soil application of elemental Sulphur @ 20 kg/ha at the time of sowing and two foliar sprays of 0.5% $FeSO_4$ with 0.2 % citric acid on appearance of yellowing at the interval of 15 days reduced the yellowing by 58 % and increased average pod yield of groundnut by 20% over the farmers practice. The increase in gross monetary return was also realized due to this practice to the extent of 25.5 % (Fig. 8). The highest CBR of 1: 2.36 was recorded in the treatment as against CBR of 1.92 in the farmers practice. The adoption level of this technology in project area is 20% and it is 6% in near by villages.

Management of yellowing (left side) with elemental sulphur +$FeSO_4$+citric acid

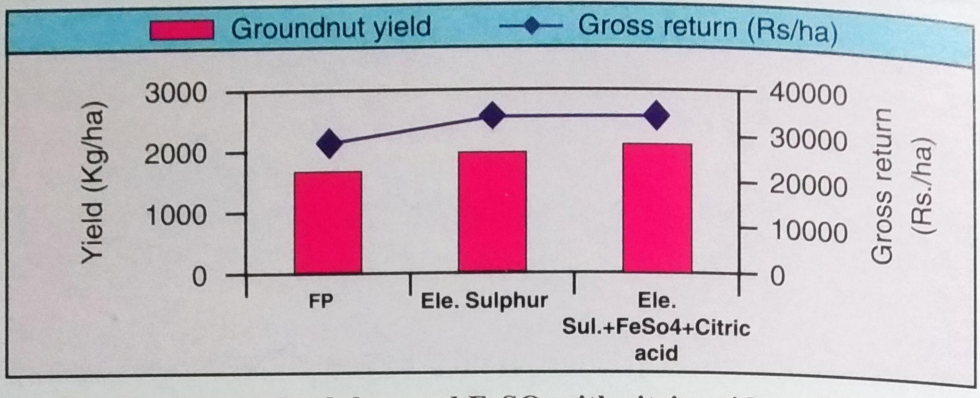


Fig. 8: elemental sulphur and $FeSO_4$ with citric acid on yield and gross monetary return of groundnut

9. GW 273 : Improved wheat variety for higher yield

Irrigation water is very scare in the project area, especially during Rabi and summer season. Farmers grow wheat in a limited area as per the availability of irrigation water. However, the productivity of wheat crop is low mainly due to non adoption of improved variety. Simply replacing the local variety (lok-1) with improved variety of wheat GW 273 during 2002-2003 increased the grain yield by 19%. The gross monetary return was also higher (Rs.40091/ha) in the improved variety as compared to local variety (Rs. 31313/ha) (Fig. 9).

wheat variety GW 273 (right) increases yield

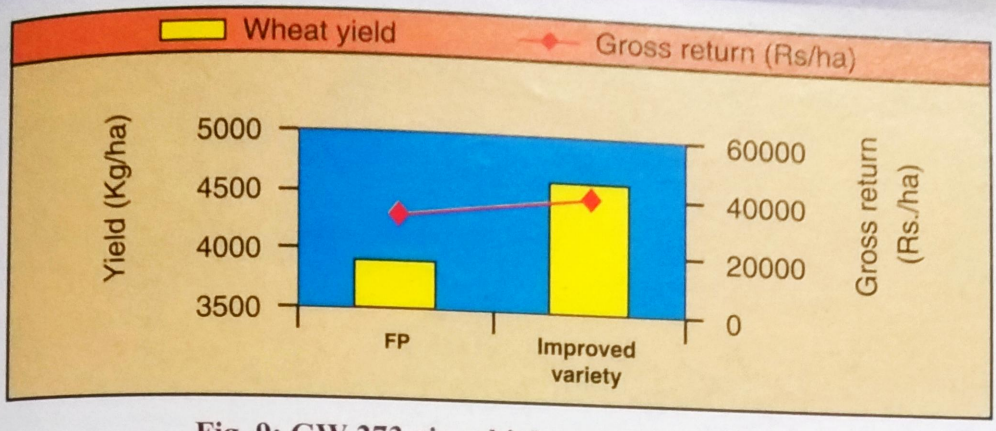


Fig. 9: GW 273 gives higher return to farmers

10. Imparting skills of silage preparation

Farmers were experiencing scarcity of green fodder during the lean period for feeding their milch cattle. Therefore, silage making of fodder sorghum/maize was demonstrated during 2000-2003 by utilizing the expertise and facilities of Cattle Breeding Farm of Juangadh Agriculture University, Junagadh to the farmers of the project area. After demonstration, farmers prepared the sorghum silage themselves at Cattle Breeding Farm. After 21 days of incubation period, sorghum fodder silage of one tone was distributed to the farmers for feeding their milch buffaloes along with the farmers' practice (dry fodder of groundnut) for 20 days. Farmers observed that the milch animal gave 15% higher milk yield per day when fed with silage of Sorghum + mineral mixture compared with farmers practice (groundnut dry fodder). Silage of Sorghum besides giving higher milk yield also recorded the maximum gross monetary return of Rs. 90.86 as against Rs. 78.82 per day/animal in farmers practice.

This will certainly help to meet green fodder shortage in lean period which very well fits in existing farming system and also enhances the income of farmers.

Learning skills of silage making

11. Ureatreated wheat straw : Feeding diet for dairy cattle

Groundnut haulm is used as dry fodder for feeding animals in Saurashtra area, while wheat straw is used mostly as a bedding material. Wheat straw contains 0% DCP (Digestible Crude Protein) and is low in calcium and phosphorus. Therefore, it is termed as non-maintenance roughage. However, its calory value is high. In view of the paucity of roughage sources, wheat straw has to be utilized by dairy farmers. In many parts of Gujarat it is burnt on the fields after harvesting. Ammoniation of wheat straw enhances its nutritive value. On the other hand groundnut haulm is rich in protein, calcium and phosphorus but lower in calory. Feeding of both these byproducts together would balance nutritional deficiencies. Farmers were convinced to take up this activity. An enriched fodder was given to the Buffaloes along with farmers practice for 30 days. Farmers observed that milch animal gave 16.9% higher milk yield per day when fed with enriched (Urea treated wheat straw + Mineral Mixture) compared with their own practice (dry groundnut fodder). Enriched fodder besides giving higher milk yield also recorded the maximum gross monetary returns of Rs. 171.64 as against Rs. 146.72 per day/animal in farmers practice