Impact of improved production technology and mechanized decortication of groundnut (*Arachis hypogaea* L.) on productivity and income of farmers in Ramanagara district of Karnataka

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ABSTRACT

The major production constraints in groundnut cultivation in Ramanagara district, Karnataka are low seed replacement, growing old varieties with less productivity and high susceptibility to leaf spots and tikka diseases, lack of awareness on the use of micronutrients and manual decortication leading to drudgery of farm woman. Krishi Vignana Kendra, Ramanagara has conducted FLDs to show the productivity potential and profitability of improved technologies of groundnut and mechanical shelling in farmers' fields. The results revealed that the mean yield increased by 29.1 per cent over farmers' practice in FLD plots. Mechanized power operated shelling decorticator, shelled 62.5 kg/h, at an efficiency of 90.9 per cent. The efficiency was 50 per cent higher than manually peeling, which made the groundnut shelling faster and more thorough in manual operated shelling decorticator. Exclusive shelling performance of power and manual operated decorticator was evaluated. Power operated sheller was efficient than manual operated sheller recording higher shelling efficiency of 77 per cent and less mechanical damage 1.1 per cent over manual operated sheller which recorded 66 and 2.9 per cent, respectively.

Keywords: Extension gap, GKVK-5 variety, Groundnut decorticator, Manual peeling, Mechanization, Technology gap

In India, Gujarat is the leading producer of groundnut (*Arachis hypogaea* L.) contributing 34.83 per cent of total production followed by Rajasthan (15.52 %), Tamil Nadu (12.96%). Andhra Pradesh (11.78%) and Karnataka (7.12%). In Karnataka normal area under groundnut is 5.91 lakh ha, with a production of 4.85 lakh tonnes (NMOOP, 2017). About 70 per cent of the crop is grown in black soil and the remaining in red soils. Ramanagara in Karnataka is one of the major districts, where groundnut is being grown in kharif, rabi and summer seasons. The, normal area under groundnut in Ramanagara is 7373 ha with a production of 4604 tonnes and productivity of 624 kg/ha (https://ramanagara.nic.in/en/district-at-a-glance). The major production constraints in Ramanagara district are low seed replacement, growing old varieties with less productivity and high susceptibility to leaf spots and tikka diseases and lack of awareness on the use of micronutrients among farmers. Among the various micronutrients, sulphur, zinc and boron play a key role in promoting growth, seed yield, oil content and quality of groundnut crop. In order to achieve the required production level of groundnut through higher productivity, in depth analysis of groundnut production methods and adoption pattern of technology is necessary (Hruday Ranjan *et al.*, 2014). The present study was undertaken to assess the impact of improved production technologies of groundnut and mechanized shelling on farm productivity and income of farmers in Ramanagara district of Karnataka during 2016-17 and 2017-18.

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MATERIALS AND METHODS

Krishi Vigyan Kendra, Ramangara conducted frontline demonstrations (FLDs) to show the production potential and profitability of improved technologies of groundnut crop. The improved technologies included high yielding variety GKVK-5, seed treatment with chlorpyriphos @ 15 ml/kg seed followed by bio-fertilizers rhizobium and phosphorus solubilizing bacteria each @ 25gm/kg seed, recommended dose of fertilizers (25:50:25 kg NPK/ha), zinc (10 kg/ha), boron (4.5 kg/ha) and gypsum @ 500 kg/ha and mechanized harvesting. Fifteen FLDs were conducted during 2016-17 and 20 FLDs during 2017-18. Due to erratic rainfall, during 2017-18 10 FLDs were conducted in *kharif* and five each in *rabi* and summer, respectively. The frontline demonstrations were conducted in six adopted villages *viz.*, Basvenahalli, Sri Rampur, Bachenahatti, Gundamanapalya, Gejgarpalya and Motganalli of Magadi taluk, Ramangara district of Karnataka. During two years of study, 35 demonstrations covering an area of 14 hectares with plot sizes varying from 0.4 to 0.2 ha were conducted. Before conducting FLDs, a pre-season training was imparted to the selected farmers regarding different aspects of groundnut cultivation. The demonstrations were conducted in farmers' fields during both the years under irrigated and rainfed conditions. In rabi and summer, the demonstrations were conducted under protected irrigation. In the year 2016-17, the crop was grown under both protected irrigation and rainfed condition. The soils of demonstration plots ranged from medium to high nutrient status, while found deficit of zinc and boron micronutrients.

Farmers practice (FP) of cultivation of local variety samrat (3 seeded pods) was taken as control. Visit of farmers and the extension functionaries was organized at demonstration plots to disseminate the message on a large scale.

Farmers practice included local variety, farmer's method of sowing, weed management and nutrient management. The data were collected from both FLD plots and farmers' practice plots. The extension gap, technology gap, technology index and benefit cost ratio were worked out (Semim *et al.*, 2000). Extension gap is the difference between demonstrated plot yield and farmers practice plot yield. Technology gap is the difference between potential yield and demonstrated plot yield. The technology index shows the feasibility of evolved technology at the farmers' fields.

Technology gap = Potential yield - Demonstration Yield
Extension gap = Demonstration yield - Farmers practice Yield

$$\text{Technology Index} = \frac{\text{Potential Yield - Demonstration yield}}{\text{Pot ential yield}} \times 100$$

Evaluation of shelling performance of different methods of groundnut decortication: One of the major problems in groundnut production in Ramanagara district is the lack of groundnut shelling machines available to farmers increasing the time spent on shelling and drudgery of woman. Farmers in the district normally follow manual shelling of groundnut. Demonstration and evaluation of power operated groundnut decorticator was taken in comparison with manual operated and manual shelling of groundnut pods. The performance of the power operated machine was evaluated in terms of shelling efficiency, material efficiency and mechanical damage (Table 4). Test parameters, such as shelling efficiency (%), material efficiency (%) and mechanical damage (%), as used by Kutte (2001) and Maduako (2006) in evaluating a rice threshing machine, was applied in testing a power operated groundnut decorticator. The test parameters were estimated as follows:

$$\text{Throughput Capacity (kg/hr)} = \frac{Qs}{Tm}$$

$$\text{Shelling efficiency (\%)} = \frac{Qs}{Qt} \times 100$$

$$\text{Material efficiency (\%)} = \frac{Qud}{Qud + Qd} \times 100$$

$$\text{Mechanical damage (\%)} = \frac{Qd}{Qud + Qd} \times 100$$

Where: Qs- Quantity of shelled groundnut pods (kg)
Qt = total weight of shelled and unshelled groundnut pods (kg)
Qud= Quantity of undamaged groundnut seeds (kg)
Qd= Quantity of damaged groundnut seeds (kg)
Tm= Effective time of shelling Tm (min)

RESULTS AND DISCUSSION

The data of frontline demonstration, year-wise (Table 1) and pooled data Table 2 showed that improved technology gave pod yield of 2871.0 kg/ha as compared to farmers practice (2223.5 kg/ha). There percent mean increase in pod yield was 29.1 in demonstration plot (Table 2). According to the previous reports, Malewar *et al.* (1982), Helpyati (2001) and Sumangala (2003), increase in pod yield in groundnut could be achieved by use of micronutrients. The beneficial influence of micronutrients *viz.*, Zn and B could be through activation of various enzymes and basic metabolic rate in plants, facilitated synthesis of nucleic acids and hormones, which in turn enhanced the pod yield due to greater availability of nutrients and photosynthates. Application of zinc enhances the plant growth through increased auxins and better dry matter production. Zinc improved dry matter production though the nodulation and N fixation by enhanced root growth and by activation of several enzyme systems and auxins. Whereas, boron influenced the nitrogen and carbohydrate metabolism of plants which might have contributed for the better plant growth. Application of gypsum during second intercultivation (40 DAS) has helped in improving peg formation and peg penetration thereby increasing pod formation. Gypsum being source of sulphur is known to play an important role in increasing oil content in oil seed crops thus leveraging in increasing the pod weight. Our results clearly indicated that improved technologies did have a positive impact on the yield enhancement.

The extension gap observed during different years worked out to average of 648 kg/ha (Table 3). The highest extension gap 650 kg/ha was recorded in 2016-17. Higher extension gap emphasizes that there is a need to educate farmers for adoption of improved production technologies through various extension methods such as method demonstrations on seed treatment with chlorpyriphos for control of root grub, bio-fertilizers application through seed treatment to increase availability of nutrients to the plants, line sowing with proper seed rate to facilitate proper crop stand as well as intercultivation practices, application of fertilizers based on soil test results. Subsequently these technologies may replace the conventional practices, thus reversing the trend of wide extension gap. The observed average technology gap for two years where FLD was implemented was 129 kg/ha. Lower the value of the technology gap more is the feasibility of the technologies which could be easily adopted by the farmers as they are user friendly and more acceptable by the farming community. Similar results were reported by Sonwane *et al.* (2016).

Lower the value of technology index (2.7%) more is the practicability of the technology, where farmers could easily adopt at field level. The technology index varied from 2.7 to 5.6 per cent (Table 3). As such fluctuation in technology index (ranging from 2.7 to 5.6 %) during the study period in certain locations may be attributed to the dissimilarities in soil fertility status, weather conditions, improper intercultural operations, pest and diseases management practices etc. In the study area the technology gap was high 5.6 per cent during 2017-18 compared to 2.7 per cent in the year 2016-17, this is because during the 2017-18 year, as indicated earlier, there was erratic rainfall pattern and hence the demonstrations were taken in all the three seasons (*kharif, rabi* and summer).

The economics of groundnut crop under frontline demonstration have been presented in Table 2. The results of economic analysis application of zinc (10 kg/ha) and boron (4.5 kg/ha) along with the recommended dose of Fertilizer (25:50:25 kg NPK/ha) and Rhizobium 40 g/kg of seed as seed treatment in demo plot revealed that the average gross expenditure of ₹ 41763.00 per ha, was higher than the farmer's practices ₹ 39065.30 per ha, by about 6.90 per cent. The increase in gross expenditure in demo plot was due to the additional expenditure incurred on the inputs such as high yielding variety, seed treatment, application of gypsum and recommended dosage of fertilizers which are directly related to the farmer's income and sustainable groundnut productivity. These measures are necessary to enhance the productivity as well as income of the farmers and also supply of better groundnut for the benefit of consumers. Similar study was reported by Ashok Kumar *et al.* (2014). Thus, frontline demonstrations recorded higher average gross returns (₹ 1, 57,808/ha) and average net return (₹ 1,16,116/ha). Benefit cost ratio of demonstration plot (3.7) was also more than that of the farmer's practices (3.1).

Evaluation of shelling efficiency by different methods of decortication: To work out the decorticating capacity by manual method, the average out-turn of five farm woman was estimated. It was found that on an average one person can decorticate 2 to 4 kg of groundnut per hour. The percent damage of seeds in manual decorticating is 1.73 per cent. The results are in line with Darshan Gowda *et al.* (2018). The out-turn from this method was very less and could not satisfy the market demand as it was a time consuming process.

Manual or hand operated groundnut decorticator: The time taken to decorticate same quantity (2 to 4 kg) of groundnut by manual operated decorticator machine was 30 minutes. The percent damage of seeds was 3.55%, which was relatively higher than manual peeling (1.73 %). This clearly showed that it is more advantageous to peel groundnut seeds using manual operated decorticator than only with bare hand (Table 5).

Power operated groundnut decorticator: The results of the performance of power operated groundnut decorticator indicated that the shelling efficiency was 90.9 ± 2.5 per cent on the average. The material efficiency of the sheller was found to be 89.2 ± 2.1 on an average for two varieties of groundnut demonstrated in an average of 15 farmer's field. Judging by the fact that its material efficiencies of 89.2 ± 2.1, the shelling machine was consistent in the quality of shelled groundnut seeds,.The quality of its material handling and the final product (groundnut seeds) was consistent irrespective of groundnut variety.

Table 1 Performance on growth and yield of groundnut under improved cultivation practices under FLD programme in Ramanagara District of Karnataka

Parameters	Farmers' practice Samrat variety		Improved technology GKVK-5 variety	
	2016-17	2017-18	2016-17	2017-18
Plant height (cm)	36.7	35.9	30.7	30.8
Number of branches/plant	7	7	10	10
Number of pods/plant	68	68	84	84
Number of seeds/pod	3	3	2	2
Late leaf spot scoring (%)	0.8	0.8	0.2	0.2
Seed yield (kg/ha)	2260	2187	2910	2832
Increase over check (%)	-	-	28.8	29.4
Gross cost (₹/ha)	38977	39154	42087	41439
Gross return (₹/ha)	124300	120300	159866	155750
Net returns (₹/ha)	85322.8	81146	117792	114440
B:C ratio	3.2	3.08	3.8	3.77

Table 2 Mean performance on growth and yield of groundnut under improved cultivation practices

Parameters	Average of two years (2016-17 and 2017-18)	
	Farmers practice (Samrat)	Improved technology (GKVK-5)
Number of Demonstrations	15	20
Villages covered	6	6
Area covered (acres)	15	20
Plant height (cm)	36.7	30.7
Number of branches/plant	7	10
Number of pods/plant	68	84
Number of seeds/pod	3	2
Late leaf spot scoring (%)	0.8	0.2
Seed yield (kg/ha)	2223	2871
Mean Increase over check (%)	-	29.1
Gross cost (₹./ha)	39065	41763
Gross return (₹/ha)	122300	157808
Net returns (₹/ha)	83234.4	116116
B:C ratio	3.1	3.8

IT = Variety GKVK-5, RDF: 25:50:25 kg NPK/ha, Seed treatment: Chlorpyriphos 15 ml/kg seed followed by double the amount of biofertilizers Rhizobium (80g/kg of seed), Zinc - 10 kg/ha, Boron - 4.5 kg/ha, Gypsum - 500 kg/ha, mechanical decortication

Table 3 Technology gap, extension gap and technology index in groundnut cultivation

Year	Potential yield (kg/ha)	Average seed yield (kg/ha)		Increase in yield over farmers practice	Extension gap (kg/ha)	Technology gap (kg/ha)	Technology Index (%)
		Improved technology	Farmers practice				
2016-17	3000	2910	2260	28.7	650	90	2.79
2017-18	3000	2832	2187	29.4	645	168	5.6
Mean	3000	2871	2223	29.1	648	129	4.3

Table 4 Test parameters (averaged of five performances) of the power operated groundnut shelling machine

Parameters	Power operated Groundnut decorticator
Weight of total groundnut pods fed into the hopper - Qt (kg)	0.55
Weight of shelled groundnut seeds –Ws (kg)- Qs (kg)	0.37
Weight of groundnut husk removed Wh (kg)	0.13
Weight of unshelled groundnut pods, Wu (kg)	0.05
Weight of undamaged groundnut seeds, Qud- (Kg)	0.33
Weight of damaged groundnut seeds, Qd (kg)	0.04
Effective Time of shelling Tm (min.)	0.50
Throughput capacity (kg/hr)	60.0 kg/hr
Mechanical damage (%)	10.8 ± 2.0
Shelling efficiency (%)	90.9 ± 2.5
Material efficiency (%)	89.2 ± 2.1

Note =Ws +Wh; Qt =Ws + Wh + Wu; Ws= Qu + Qd; Qs- Quantity of shelled groundnut pods (kg)- (Ws +Wh); Qt = total weight of shelled and unshelled groundnut pods (kg)- (Ws + Wh + Wu,) ; Qud= Quantity of undamaged groundnut seeds (kg); Qd= Quantity of damaged groundnut seeds (kg).

Table 5 Evaluation of manual verses mechanized groundnut peeling

Particulars	Manual Peeling	Manual / hand operated decorticator	Power operated decorticator
Quantity of groundnut seeds	2 to 4 kg	2 to 4 kg	60 kg
Time taken to peel/shell	1h	30 minutes	1 h
Percent damage of seeds	1.73	3.55	10.8 + 2

Mechanical damage: On an average, the mechanical damage of the seeds was found to be 10.8 ± 2.0 (Table 4). Mechanized shelling at the rate of 60 kg/h obtainable with this machine and at an efficiency of 90.9 per cent will make the groundnut shelling operation faster and more thorough than manual shelling. Also, the material efficiency of 89.2 per cent with only a little damage of 10.8 per cent ensures a neat operation and high quality product. The sheller is operated with a 5.0 hp petrol engine, it can be used in rural areas where there is no electricity supply, but in urban areas, when there is electricity supply, the engine can be replaced with a 5.0 hp electric motor for the shelling operation. The efficiency of the machine is 40 % higher than manual peeling.

In conclusion. the demonstrations have clearly indicated the potential of the technology package as compared to farmers' practices. Farmers realized higher profits as compared to their existing practices. Hence, the technology has to be widely disseminated among larger groups by forging necessary partnerships with agricultural department and other stakeholders. Comparison of manual decortication with mechanical (manual operated and power operated) decortications of groundnut pods indicated less damage to groundnut kernels, higher efficiency of power operated machine followed by manual operated and manual decortication. Farmers were highly convinced with the technology package and the same has spread to the farmers of 20 villages in the neighboring taluks and districts over an area of 500 acres.

REFERENCES

Ashok Kumar, Singh K N and Bhardwaj S P 2014. Factors affecting groundnut output in Andhra Pradesh co-integration and error-correction modeling. *Journal of Oilseeds Research*, **31**(1): 49-52.

Helpyati A S 2001. Effect of moisture regimes and zinc levels on the growth and yields of summer groundnut. *Karnataka Journal of Agricultural Sciences,* **14**(2): 451-453

Hruday Ranjan C, Satya Gopal P V, Sailaja V and Prasad S V 2014. Extent of awareness, knowledge and adoption of different farm machinery by the groundnut farmers in Chittoor district of Andhra Pradesh. *Journal of Oilseeds Research*, **31**(1): 86-89.

Kutte M T 2001. Reactivation and performance evaluation of the threshing unit of a combine harvester scrap for stationary threshing of rice. M.E. Thesis, Department of Agricultural Engineering, Federal University of Technology, Yola, Nigeria. pp. 47-48

Maduako J N, Saidu M, Matthias P and Vanke I 2006. Testing of an engine-powered groundnut shelling machine. *Journal of Agricultural Engineering and Technology*, **14**: 29-37.

Malewar G U, Jadhav N S and Budhewar L 1982. Possible role of Zn in nodulation and other growth attributes of groundnut. *Journal of Maharashtra Agricultural Universities*, **7**(3): 241-242.

NMOOP 2017. https://nmoop.gov.in/Publication/Status Paper on Groundnut. https://ramanagara.nic.in/en/district-at-a-glance.

Sumangala B J 2003. Response of groundnut (*Arachis hypogaea* L.) to conjunctive use of micronutrients and bio-inoculants at graded levels of fertilizers under dry land conditions. Ph.D. Thesis, University of Agricultural Sciences, Bengaluru.

Sonawane K G, Pokharkar V G and Gulave C M 2016. Impact of improved production technology of groundnut (*Arachis hypogaea* L.) on farm productivity and income in Western Maharashtra. *Journal of Oilseeds Research*, **33**(2): 138-145.

Samui S K, Maitra S, Roy D K, Mandal A K and Saha D 2000. Evaluation of front line demonstration on groundnut. *Journal of the Indian Society of Coastal Agricultural Research*, **18**(2): 180-183.

Wijnands J H M, Biersteker J and Van Loo E N 2009. Oil seed business opportunity in Ethiopia. *Oilseed Research Report,* Addis Ababa, Ethiopia.