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IMPACT OF GROUNDNUT (*ARACHIS HYPOGAEA* L.) AND THEIR IMPROVED VARIETY IN CHHATARPUR DISTRICT UNDER BUNDELKHAND REGION OF MADHYA PRADESH INDIA-A CASE STUDY

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ABSTRACT

After several efforts to popularize the improved variety TG 37 A of Groundnut along with Suitable package and practices since *kharif* 2013 are being taken up in District Chhatarpur by KVK for enhancing the yield and income of farmers. Because most of the farmers lack of knowledge about high yielding diseases resistant varieties and thereby harnessing lower yields and their impact on limited net returns. The performance of Groundnut production through varietal replacement under central portion on the plateau of Bundelkhand region in Madhya Pradesh, showed that by the end of 2021, 12 and 71.4 per cent area has been occupied with Groundnut and their improved variety 'TG 37 A with an increase in yield by 555 kg per ha and net returns by 82.2 per cent over locally cultivated varieties. Maximum yield (15.20 q/ha) was obtained during 2021-22. During 2018-19 and 2019-20 (rainfall during crop period 1166 & 642.7 mm) the improved variety of groundnut (TG 37 A) produced lower yields (1402 & 1415 q/ha) which showed that this variety can also perform better under average rainfall regime. The returns per rupee investment varied between 2.7 to 2.9 whereas it was 1.3 to 1.4 in locally cultivated varieties with traditional farmers practice during 2016 to 2021-22.
Keywords: Economic impact, Improved varieties, Impact and Spread of technology.

Introduction

Groundnut (*Arachis hypogaea* L.) is one of the premier oil seed crops of tropical and subtropical regions of the India. It is known as wonder nut and poor man's cashew nut and belongs to the family Fabaceae (Shah and Pramanik, 2020). It contributes more than 50 % of the edible oil production in our country (Suseendra *et al*., 2019). In India, groundnut is grown over an area of 4076 thousand hectares during *Kharif* season with a production of 7365.3 thousand tonne and productivity 1807 kg ha^{-1} during 2018 (Anonymous, 2018). National productivity is higher than state and district productivity 1025 and 1113 respectively (Anonymous 2019) The per capita availability of oil seeds is 13 g day^{-1} $person^{-1}$, which is much below the recommendation of Indian Council of Medical Research (35-40 g day^{-1} $person^{-1}$) (Shah and Pramanik, 2020). So, there is an urgent need to explore the possibilities for increasing the productivity of oil seed crops especially in groundnut by overcoming all production losses through introduction of disease resistant high yielding variety, seed treatments with appropriate fungicide and balance dose of fertilizers. Besides these Chhatarpur District is characterized by sub-tropical climate with average annual precipitation of 1000-1200 mm (80% of rainfall received during June-September) and temperature range from 16-42C. Land being undulated in nature, tends to erosion of top soil leading to poor status of N, P, K and organic matter. Soil texture is sandy to sandy loam, rich in iron and aluminium but deficient in Ca, Mg, B and Mo. Water retention capacity of soil is poor. Therefore, this area is dominated by cultivation of blackgram, Sesame, Soybean and Green gram in Kharif season. Area under

dominated crops cultivation is decreasing day by day due to erratic, uneven and scanty rainfall. Still the major cropping pattern of the district is Groundnut-Chickpea- fallow. A large tract of Chhatarpur district comes under such red, yellow sandy loam and sandy clay where the cropping system is dominantly Groundnut-Chickpea/Wheat. They provide fulfill all the requirements of farmers. Sporadically a few farmers tried several other crops and vegetables, but the success of sustainable crop cultivation to replenish Groundnut eluded them. Because a group of farmers from Village Chokheda and Singrawankala approached the KVK during 2011-12 seeking advice to find an alternate crop for this area which provided an assured return in terms of productivity and marketability. Realizing the magnitude of the problem, the KVK opted for agro-ecosystem analysis through PRA in the villages to characterize the present agricultural situation and identify the opportunity to introduce a new crop as per the need of the practicing farmers. During formal and informal meeting with farmers, Visit, interaction and detailed survey helped the KVK to identify such a crop that would suit the existing climate. Finally, the KVK decided to introduce 'groundnut' in the selected villages as an alternate crop for that area.

Material and Methods

In the initial years, the KVK demonstrated the performance of one varieties of groundnut namely TG 37 A under NICRA Project in a number of locations of those villages to find out the best suited variety or this identified agro-climatic condition during 2011-12. Extension functionaries of line departments were involved in the standardization of cultivation process. Finally the KVK came up with the recommendation of complete package for the cultivation of TAG-37 A variety with seed treatment of Rhizobium @ 200 g/ha, soil application of PSB and KSB @ 5 kg/ha at the time of sowing with 75 % recommended dose of fertilizers NPK @25:50:25 kg ha along with ZnSo4 25 Kg and borax @ 10 kg/ha. The package was further demonstrated by KVK through conducting front line demonstrations in 5 ha area during Kharif season with TG 37 A variety and one spray of imazethapyer and Quizalofop p tehyle @ 75 g+ 37 g a.i./ha at 15 days after sowing for weed management. The performance of the crop was compared with the farmer's practice on the same location, which included use of only 50 kg DAP per ha, higher seed rate (125 kg/ha) and sowing of seeds without seed treatment with fungicides and bio fertilizers. The soil of demonstrations site belonged to Sandy loam. The Groundnut crop was sown between First week of July and harvested during second week of October. The seed rate of improved variety of Groundnut (TG 37 A) was used @ 100 kg per ha. Soil test based tailored NPK fertilization was applied as basal form. The crop was protected from insect-pests and diseases as per recommendation. The yield data from demonstration field and farmer's crop was collected after harvesting the crop. In subsequent year (2016-2021), the horizontal spread of the improved variety (TG 37 A) in the Farmers field of district was made through frequent farmers contact, interface with farmers, training to farmers and Rural Agricultural Extension Officer (RAEO), Krishak Sangoshthi and field days about good attributes of the variety. In addition, the progressive farmer of the district also disseminated the information about improved variety among the farming community through personal contact in subsequent years of study. For economic evaluation in term of gross and net return and cost benefit ratio, the prevailing rates for input, labour and produce was utilized. Rainfall data were also recorded during the study period to analyze the performance of the variety (TG 37 A). For getting feedback about the introduced variety from groundnut grower a comprehensive questionnaire was developed. The informations were mainly collected with due cooperation of RAEO through comprehensive questionnaire in the District. The personal interviews with the RAEO and farmers were also conducted for getting the feedback in the study area.

Results and Discussion

Change trend in area of Kharif crops

Groundnut crop has covered 55342 ha area out of 401390 ha area of Kharif crops in Chhatarpur districts. 13.7 percent area under Groundnut was observed during 2020-21 against 2.8 % during 2016-17 (Fig 2 and 3). While reduce fallow area and soybean & green gram cultivated area from (21350 to 19752 ha and 31900 to 19400 ha) respectively during 2016-2021 (Table 1 and Fig 1). And presently groundnut crop has been covered 55000 ha out of 401390 ha area of Kharif crops in Chhatarpur districts (Fig 2). During 2021-22 was found 12.0 percent area spread under Groundnut since 2016 (3.7%) out of hole area of Kharif crops and reduce soybean & green gram cultivation area 63.1 and 68.6 percent respectively due to adoption of improved production technique of Groundnut (Table 1). Because soybean, green gram and black gram crops have been susceptible to biotic and a biotic stress due to dominancy of their monotomy cropping system in this region. Therefore, production and productivity were stagnated or decline against to their potential/average productivity due to heavy infestation of yellow mosaic virus, stem fly, and Rhizoctonia aerial blight. Apart

from these, premature shedding of flowers, pods and leaves also causes reduction in yield under stress conditions in accordance with Singh *et.al*. (2016). And less sensitive to a biotic stress as like erratic climatic condition i.e. either heavy rainfall or long dry spell during crop period. In this situation KVK Chhatarpur has been introduce improved variety (TG 37 A) of groundnut and promotion of cultivation of Groundnut in the place of soybean, green gram and Groundnut crops. Adoption of improved variety 'TG 37 A" of Groundnut increased the seed yield by 56.7 per cent over existing varieties (Table 2). Its resulted horizontal spread of the variety TG 37 A increased by 71.4 per cent out of total area of Groundnut 55342 ha of Chhatarpur District (Fig 4). And reduce the fallow area 8.1 percent by Groundnut crop in Kharif season to fulfill requirement of oil seeds and farmers income (*Fig*.1). This was helpful to improvement of socio and economic status of farmers. Under such circumstance Groundnut crop was found suitable in Bundelkhand region due to their suitability (resistant and tolerant to biotic and a biotic stress and short duration) similar result was found in intercropping, varietal performance and suitable technological intervention by Singh *et al.* (2016), Singh *et al*. (2017) and Singh *et al.* (2019).

Yield performance

Adoption of improved Groundnut variety 'TG 37 A" increased the seed yield by 56.7 per cent over existing varieties ('Jalgaon) a span of six years of study (Table 2). Irrespective of variety and seasonal variations, the average yield achieved from improved variety was 1453.7 kg per ha as compared to that of 927.5 kg per ha under farmers practice during entire study period. It is evident from the results that the improved variety of Groundnut ('TG 37 A") performed better under average rainfall situation (Table 3). Maximum yield (15.20 q/ha) was obtained during 2021-22 when annual rainfall in Chhatarpur District was recorded as 668.2 mm. During 2018-19 and 2019-20 when higher and lower rainfall (1166 & 642.7 mm) respectively occurred in this District, the improved variety of Groundnut ('TG 37 A") also produced lower yield 1402 & 1415 q/ha which showed that this variety can also perform better under average rainfall regime. Because in both year rainfall pattern has been drastically changed either heavy or low precipitation. The yield increase with the improved variety under the farming situation of demonstration area is likely to be effective in area with similar microclimate. The year-to-year fluctuations in yield can be explained on the basis of variations in microclimate condition of that particular place Patel *et al.* (2013) has also opined that depending on identification and use of farming situation, specific interventions may have greater implications in enhancing systems productivity. Yield enhancement in different crops in front line demonstration has amply been documented by Singh *et al.* (2013) and Singh *et al.* (2016).

Uptake, Spread and Benefits of Variety

Gradually horizontal spread of the technology started taking place and within next six years about 120 ha of area could be brought under groundnut cultivation in 2016-17. YMV, Phytophthora and water scarcity was a severe problem for the farmers to cultivation of black gram and green gram. However, cultivation of groundnut was possible in above mentioned problems which were affordable for the farmers. Moreover, cultivation of groundnut has positive impact on soil health, created more man-days and ultimately led to less migration of labour from rural to urban areas. Groundnut has a good market in Chhatarpur as well as neighbouring districts also which enabled the farmers to get instant return and encouragement for groundnut cultivation. Cultivation of groundnut has not confined to Chhatarpur district. Farmers of identical agro-climatic situations in Chhatarpur districts also have started adopting groundnut in place of Black gram, soybean and green gram.

Horizontal spread of the variety

The demonstration conducted in the farmers' field was appreciated by the neighbouring farmers also. They too were interested in following the similar technical intervention in their fields. The variety TG 37 A had covered about 39500 ha till the reporting period 2021-22. Improved Groundnut variety ''TG 37A was sown only in 5 ha area during *kharif* 2011-12 in village Chowkhada. And in the second year this variety occupied 30 ha area in other farmer's fields by fellow farmers. During 2021-22, the horizontal spread of the variety ''TG 37A increased by 71.4 per cent (39500 ha) out of total area of Groundnut55342 ha area of chhattarpur district (Table 2). Before adoption of this variety the farmer used to harvest an average production of Groundnut of 927.5 kg per ha, and now the same farmer is producing 1349.2 kg per ha of Groundnut. The better performance of Groundnut variety over others grown at the location appears on account of its trait of doing well under either higher or lower rainfall conditions, better germinability, inbuilt moderately resistance to *tikka* disease and tolerance to insect-pests. This makes it possible to optimize productivity of groundnut by adoption of variety ''TG 37A" in light and heavy black soils of medium to high

rainfall regions. Similar report was found in blackgram crops by Singh *et al.* (2016) and Singh *et al.* (2019).

Economic evaluation

From the yield performance and economic impact of groundnut var. TG 37A, the farmers are convinced for growing the variety in large scale areas that will easily improve the economy and also support the welfare of the farmers. The cost of cultivation in improved cultivar was comparatively higher (Rs. 21000 - 31500) as compared to farmer's practice (Rs. 19500-26500) on account of additional input provided in the demonstration. Higher gross returns (Rs. 60900–84360) and net returns (Rs 38900-53860) were obtained from improved variety (TG 37A) as compared to local cultivar (Rs. 37136-53557) and (Rs. 17636-27057) respectively. The average net return obtained from improved variety was 99.2 per cent higher over locally cultivated varieties (Table 3). The returns per rupee investment were accordingly reflected in improved variety (2.6 to 2.8) as compared to locally cultivated varieties (1.9 to 2.0). The variation in cost of cultivation during study period is attributed to variation in cost of inputs and that of produce. The result suggests economic viability and agronomic feasibility of adopted module in soybean cultivation. The results are in conformity of findings reported by Singh *et al.* (2016) and Singh *et al.* (2019).

Impact of technology

The achievements and outcome of improved variety (TG 37 A) are outstanding. Groundnut has registered significant increase in productivity and returns per rupee investment. The average yield of improved variety (TG 37 A) of Groundnut has exhibited 45.5 per cent increase in yield against to farmers locally cultivated varieties. This is primarily due to introduction of high yielding and disease resistant variety along with improved technology against farmer practices as cited by Singh *et al*. (2013), Singh *et al.* (2016) and Singh *et al.* (2019). who reported similar report in soybean and chickpea crops. Nearly 16657.2tonnes additional yield was obtained from adoption of improved variety (TG 37 A) in 39500-hectare area in the Chhatarpur district. It could be possible mainly due to effective dissemination of improved variety and production technique (TG 37 A) of Groundnut crop by bringing awareness among farmers and farm women along with RAEO of the village through various field-oriented activities, training programme and availability of literature related to package and practices of Groundnut crop in accordance with Singh *et al.* (2017) and Singh *et al.* (2018).

Feed back of Groundnut growers

Adoption of a given variety (TG 37 A) is usually a process, which passes through awareness about the variety, assessment of the expected returns from the variety, the farmer may then decide to grow. Good performance of the variety was observed during evaluation with the farmers. For getting feedback about the variety, approximately 20 rural extension officer and 200 farmers were interviewed through comprehensive questionnaire in the study area under NICRA adopted village. Since this variety has tolerance to excessive soil moisture or long dry spell during crop period, resistant to Tikka diseases and tolerant to insect and pests therefore, it was found suitable in terms of increased profitability and reduced risk. The farmers decided to switch off the other variety and adoption of this improved variety. Scientist gain insights about the level of adoption and the underlying factors that constraint or facilitate the adoption process, it is useful to examine the factors that determine technology uptake similar result was found in Pigeonpea and chickepea crop under front line demonstration by Singh *et al.*(2017) and Singh *et al.* (2019). This information is important to both researchers and policy makers. The researcher would gain useful feedback on the level of uptake of the variety/technology by the Groundnut growers and the attributes of the technology that conditioned the level of adoption. This can be useful in decision to develop well-suited variety that meets the needs of the target of increasing population in future. Policy makers can use such information to reform the policies that slower down the technology uptake or formulate and implement new instruments that hasten and support the adoption process.

Conclusion

The farmers of Chhatarpur district have been sowing the improved variety (TG 37 A) of Groundnut crop consistently since last 11years which brought out significant increase in yield of Groundnut crop that leads positive socio-economic changes in their life. The study also suggests that similar kind of approach can effectively convince the other farmers in other villages to adopt improved variety (TG 37 A) with recommended package of production to optimize their productivity which may effectively contribute to increase the national production of Groundnut.

Table 1 : Change trend in area of Kharif crops in Chhatarpur District

Year	Area under improved var	Area under Groundnut (000ha)	Kharif area (000ha)	Fallow area (000ha)	Reduce fallow area (%)	Varietal spread of groundnut (%)	Area spread under groundnut (%)	Soybean area (000ha)	Green gram (000 ha)	Area under both crop (Soy+ Gr.gram)	Replace soybean and greengram by Groundnut (%)
2016-17	120	11352	309890	18200		1.05	3.8	57658	9624	67282	
2017-18	305	14024	337043	17500	3.8	2.17	4.2	29567	12332	41899	37.7
2018-19	1800	11765	336623	15500	9.1	15.3	3.5	23781	10576	34357	48.9
2019-20	4500	20331	413259	14500	20.3	22.1	4.9	37300	5696	42996	36.0
2020-21	9500	35620	459420	13600	25.3	26.7	7.8	35020	3820	38840	42.2
2021-22	39500	55342	459420	13200	27.5	71.4	12.0	21300	3020	24320	63.0

Table 2 : Horizontal Spread of Improved Variety (TG 37 A) of groundnut and their productivity in District Chhatarpur

Year	Horizontal Spread (ha)		Horizontal Spread of improved variety and Groundnut (%)		Average yield (kg/ha)	
	TG 37 A	Horizontal spread of Groundnut	TG 37 A	Horizontal spread of Groundnut	Improved variety along with package and practices	Locally cultivated varieties
2016-17	120	11352	1.05	3.8	1450	880
2017-18	305	14024	2.17	4.2	1350	900
2018-19	1800	11765	15.3	3.5	1402	950
2019-20	4500	20331	22.1	4.9	1415	925
2020-21	9500	35620	26.7	7.8	1480	945
2021-22	39500	55342	71.4	12.0	1520	965
					1349.2	927.5

Table 3 : Effect of Rainfall on the production of Groundnut in District Chhatarpur

Year	Rainfall (mm)in Kharif season (June-Sept.)	No. of rainy days	Average yield (kg/ha)	
	Chhatarpur District		TG 37A	Local cultivated varieties
2016-17	773.6	**29**	1450	880
2017-18	974	57	1455	900
2018-19	1166	66	1402	950
2019-20	642.7	29	1415	925
2020-21	678	45	1480	945
2021-22	870	46	1520	965

Table 4 : Economic Evaluation of Horizontal Spread of Improved Variety of Groundnut (TG 37 A) in Chhatarpur District

Year	Average cost of cultivation (Rs./ha)		Gross returns (Rs. /ha)		Net returns (Rs. /ha)		Returns/Rupee investment	
	Improved practices	Local practices	Improved practices	Local practices	Improved practices	Local practices	Improved practices	Local practices
2016-17	21000	19500	60900	37136	38900	17636	2.8	1.9
2017-18	23500	21500	61546	40050	38046	18550	2.6	1.9
2018-19	25500	23000	68417	46455	42917	23455	2.7	2.0
2019-20	26800	23800	73410	47989	46610	24189	2.7	2.0
2020-21	28600	25300	78070	49848	49470	24548	2.7	2.0
2021-22	31500	26500	84360	53557	53860	27057	2.8	2.0
					44967.2	22572.5	2.7	2.0

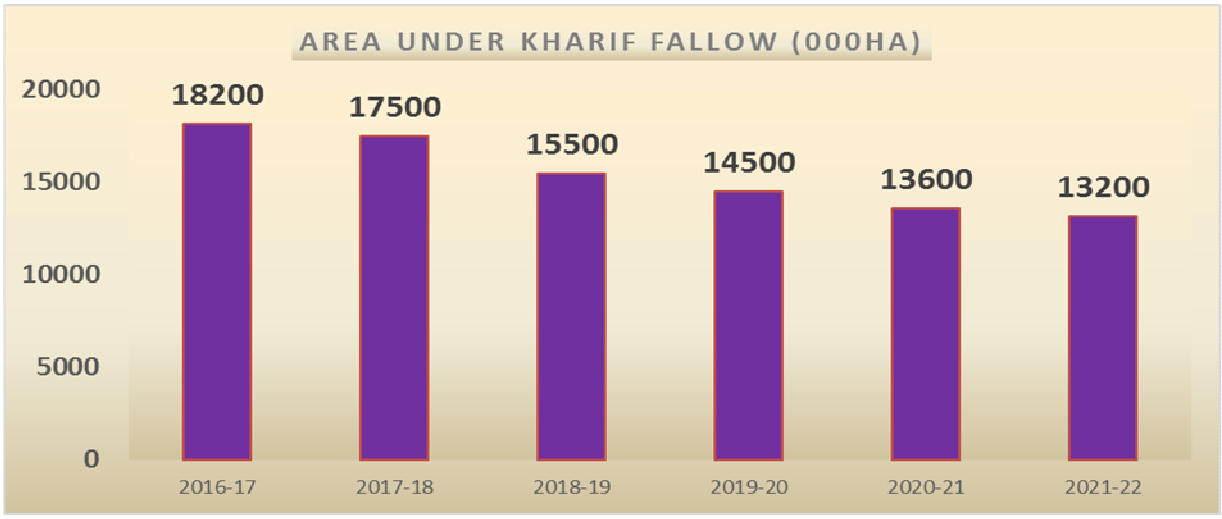

Fig. 1 : Changing Trends in area

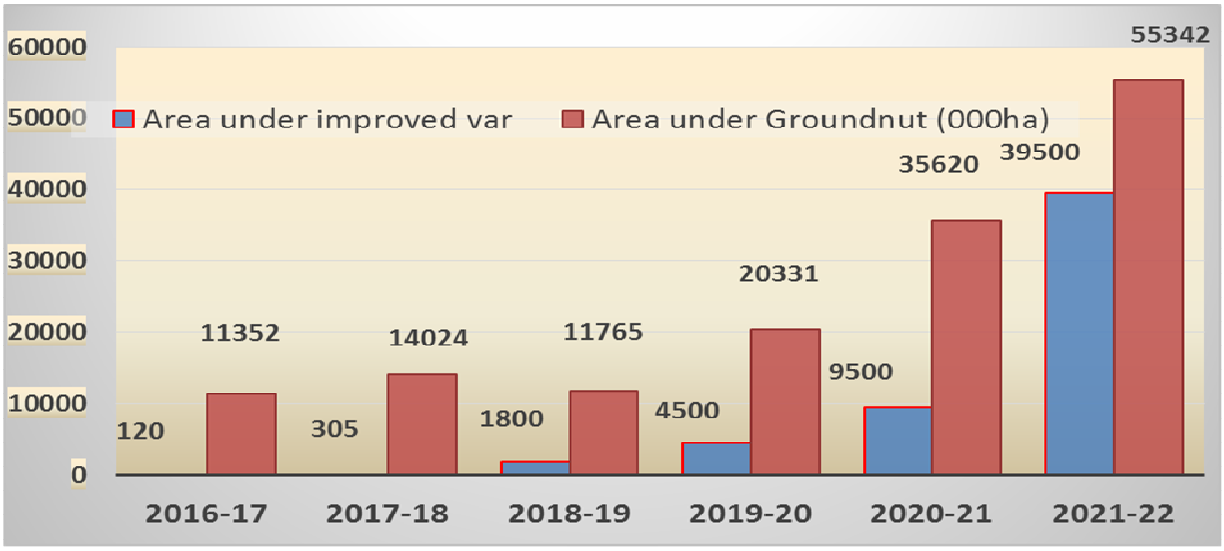

Fig. 2 : Horizontal spread of groundnut crop and their improved variety TG 37 A

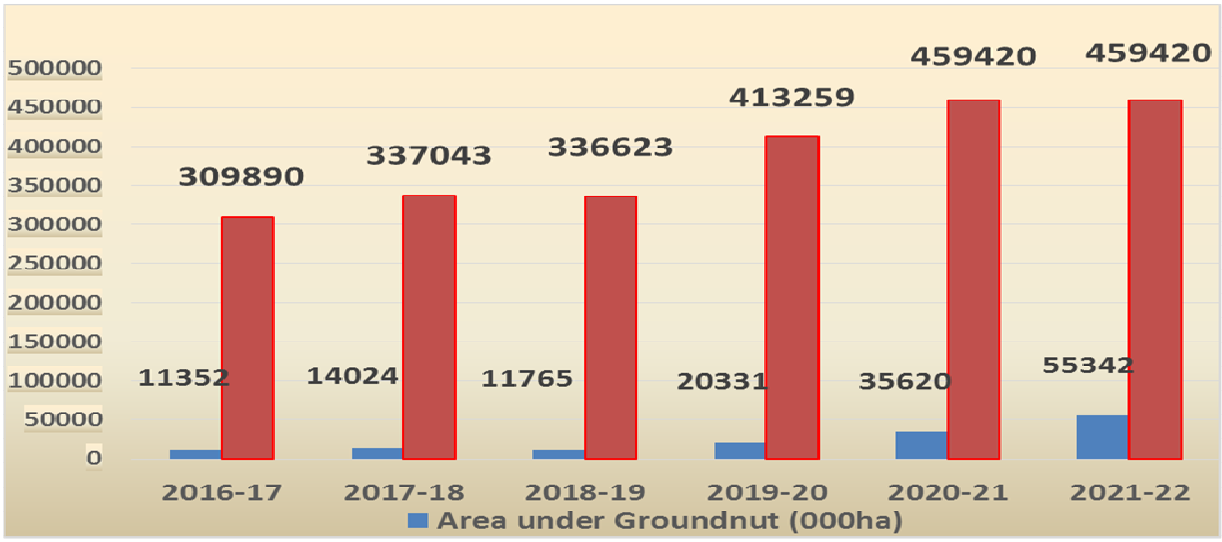

Fig. 3 : Horizontal spread of groundnut in Kharif Season during 2021

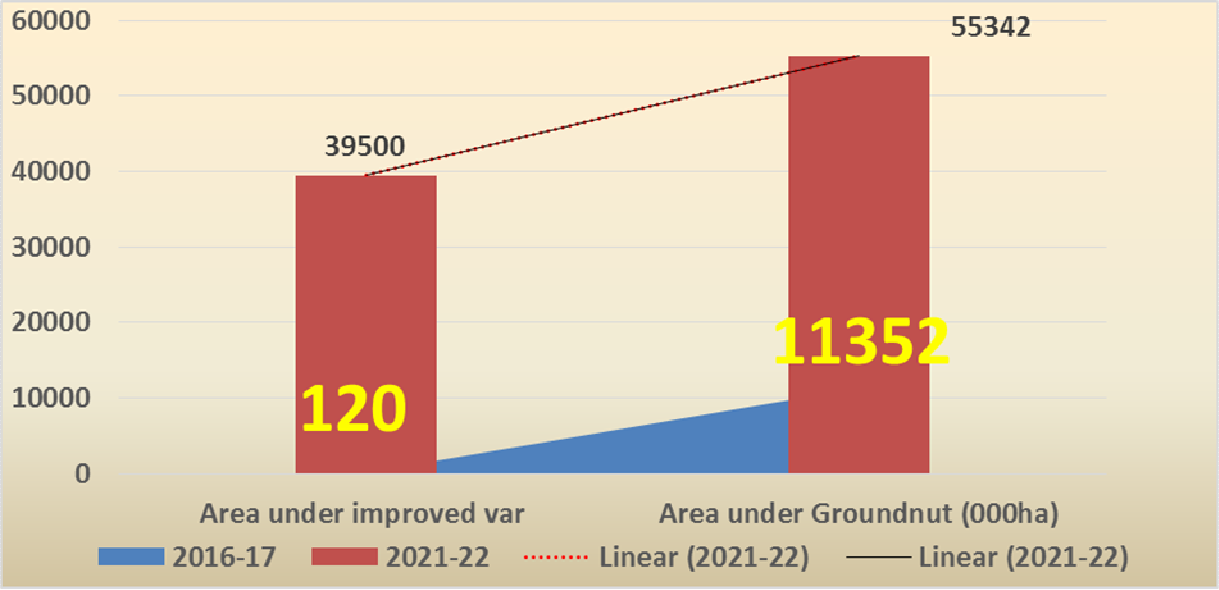

Fig. 4 : Horizontal Spread area under improved variety

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