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Effect of Foliar Application of Nitrogen through Nano Urea and Urea Phosphate on Growth, Yield and Economics of Summer Groundnut (*Arachis hypogaea* L.)

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ABSTRACT

A field experiment was conducted during *summer* season 2023, 2024 and 2025 under Mahatma Phule Krishi Vidyapeeth, Rahuri (M.S.) at research farm of Oilseeds Research Station, Jalgaon (Maharashtra), India to study the "Effect of foliar application of Nitrogen through Nano Urea and Urea Phosphate on growth, yield and economics Summer Groundnut (*Arachis hypogaea* L.)". The experiment was laid out under Randomized Block Design with three replications with ten treatments. The three treatment consisting of 100, 75, 50 % RDF (recommended dose of fertilizer), three treatments consisting of 100, 75 and 50 % RDF with combination of 0.2 and 1 % nano urea and urea phosphate spray at flowering stage, three treatments consisting of 100, 75 and 50 % RDF with combination of 0.2 and 1% spray of nano urea and urea phosphate at flowering and peg formation stage, respectively and one treatment consisting of 100 % RDF + 2% urea spray at 30 and 60 DAS, respectively were applied to the groundnut var. JL-776 (Phule Bharati) with uniform application of 10 ton of FYM to all the treatments as per recommendation.

The results showed that, application of 100% RDNPK + (0.2% Nano urea + 1 % Urea phosphate) at flowering stage & peg formation stage (T_7) to groundnut produced significantly highest groundnut dry pod yield (2933 kg/ha), haulm yield (5381 kg/ha), gross returns (Rs.1,81,376/ha), net returns (Rs.1,17,470/ha) and B:C ratio 2.84 over Control. Treatment T_7 was found at par with T_1 + foliar application of urea @ 2% at 30 & 60 DAS (T_{10}) and T_2 + application of (0.2% Nano urea + 1 % Urea phosphate) at flowering stage & peg formation stage (T_8).

Keywords : Nano urea, Urea phosphate, Yield, Economics, Summer groundnut, Foliar application.

Introduction

Groundnut (*Arachis hypogaea L.*), also known as peanut, is an important oilseed and legume crop cultivated widely in tropical and subtropical regions. It plays a significant role in agricultural economy due

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to its high oil content, soil improving properties, and multiple uses in food, feed, and industrial products. Being a crop with high nutrient demand, adequate and balanced fertilization is critical for achieving optimal growth and productivity. Among essential nutrients, nitrogen (N) is a key element that influences vegetative growth, pod formation, and overall yield of groundnut. However, conventional soil application of nitrogenous fertilizers often results in low nutrient use efficiency due to losses through leaching, volatilization and denitrification. This not only reduces crop productivity but also increases production costs and environmental pollution.

Groundnut has a distinct position among the oilseeds as it can be consumed and utilized in diverse ways. It is rich source of edible oil (44-55%), high quality protein (22-36%) and carbohydrates (6-24%) and hence, it is valued both for edible oil and confectionary purposes. Groundnut kernel are consumed as raw, boiled, roasted or fried products also used in a variety of culinary preparations like peanut candies, butter, peanut milk and chocolates (Desai *et al.*, 1999). Cake left after extraction of the oil is an excellent feed for livestock. Vegetative parts of groundnut like leaf and stem are good source of nutritionally high quality fodder for farm animals.

Nano fertilizers play significant role in the crop production up to 35 to 40% of the productivity. Below 50 nm size, the laws of classical physics give way to quantum effects, provoking different optical, electrical and magnetic behaviors. Nano sized active ingredients in fertilizer help to improve nutrient use efficiency and this could be due to their high specific surface area, which facilitates good absorption of the nutrients. The distribution of nano NPK element was found to be uniform and their use efficiency was 97.43 %, 98.11% and 97.03 %, respectively (Chouriya *et al.*, 2020).

Green revolution had led to the increased consumption of chemical fertilizers which resulted in the higher productivity on one hand, whereas on the other hand it also caused environmental hazards. Nutrients use efficiency of conventional fertilizers is very low. To overcome all the drawbacks in a better way, nanotechnology can be ray of hope. Nano fertilizers is an important tool in agriculture to improve crop growth, yield and quality parameters with increased nutrient use efficiency, reduction in wastage of fertilizers and cost of cultivation. Nano fertilizers are applied either to soil and or leaves. Foliar application can be during unfavourable soil and weather conditions. In addition to this, it promotes the direct entry of nutrients into the plants system, thus reduce the wastage of fertilizer. Hence foliar application of nano fertilizers leads to higher nutrient use efficiency (NUE) and has given a rapid response to the growth of crops.

The application of nano-fertilizers (NFs) is an emerging research field in agriculture. These are materials in the size range of 1–100 nm that support the nutrition of the plants. It is a novel way to optimize the nutrient supply, either alone or in combination. NFs are an economical alternative to ordinary chemical fertilizers that can increase global food production in a sustainable way. NFs are made up of nutrients and micronutrients and may act as carriers for nutrients. The nanocarriers deliver the nutrients to the right place, reducing the additional amount of active chemicals deposited in the plant, besides a slow release. Although nano-coated materials manage to penetrate through the stomata with a size exclusion limit greater than 10 nm, the nanoparticles appear to be able to make holes and enter the vascular system. This review addresses the potential benefits of NFs to agriculture, synthesis, mode of entry, mechanisms of action, and the fate of nanomaterials in soil. Finally, policy makers will have the bases to regulate the dose, frequency, and time period of NF applications for food production.

Phosphorus is also another important mineral nutrient that has different roles in plant functional metabolism, including energy transferring of legume crops during BNF Hence, P can promote legume crops to produce their own N sources, but at the time of P deficiency, rates of BNF can be negatively affected due to reduced number of effective root nodules (Malhotra *et al.*, 2018). Phosphorus nutrition is also important for groundnut crop since it improves nodulation, significantly contributes for healthy and efficient root growth (Mitran *et al.*, 2018). Considering above facts, an attempt was made to study the effect of foliar application of Nitrogen through Nano Urea and Urea Phosphate on growth, yield and economics Summer Groundnut (*Arachis hypogaea* L.)

Materials and Methods

A field experiment was carried out during *summer* season, 2023, 2024 and 2025 at Oilseeds Research Station, farm, Jalgaon (Maharashtra) India at an altitude of 227.00 m above sea level. The region falls under agro-climatic zone VII a tropical and subtropical plain of Maharashtra. Jalgaon faces extreme of both high and low temperature. During summer maximum temperature goes up to 46^0C and in winter minimum temperature reaches near 6^0C. Receives monsoon rainfall with an average 750 mm annually. The mean annual rainfall is about 650 mm of which major portion (600 mm) is received during the monsoon season (June to September) and some times during October. For sowing of groundnut crop variety JL-776 (Phule Bharati) was used. The soil was silt-clayey (7.99 % sand, 42.96 % silt and 49.05 % clay) in texture having pH 8.0, electrical conductivity 0.19 dS/m, 5.10 g organic carbon/kg soil, 165.58 kg $KMnO_4$ oxidizable N/ha soil, 13.80 kg 0.5 $NaHCO_3$ extractable P/ha soil and 609 kg 1.0 N NH_4OAc exchangeable K/ha soil in top 20 cm soil.

The experiment was laid out in a Randomized Block design with 10 treatments with three replications. In this experiment, conventional fertilizers doses were applied through urea and single super phosphate (State RDF 25:50:00 kg/ha NPK) and 10 t FYM to all plots as common dose. The conventional fertilizers dose i.e. 100, 75, 50 % RDF was applied at time of sowing to three treatments each, Three treatments each consisting of conventional dose 100, 75, 50 % RDF at time of sowing in combination with foliar application of 0.2% nano urea and 1% urea phosphate at flowering stage and three treatments each consisting of conventional fertilizers dose 100,75, 50 % RDF in combination with 0.2% nano urea and 1 % urea phosphate at flowering and peg formation stage, respectively and one treatment consist of 100 % RDF in combination with 2 % urea at 30 and 60 DAS.

The crop was harvested at maturity 120 DAS in the season i.e. Summer 2023, 2024 and 2025.

Results and Discussion

Growth and Yield

The pods and haulm yield, produced at harvest is considered the economic yield of groundnut crop, which produces a cumulative effect of all factors contributing to better growth and thereby resulted in higher yield of groundnut per plant. It is one of the essential characters which shows the production potential of groundnut crop presented in (Table 2 and figures 1 and 2). Data pertaining to the effect of conventional of fertilizers (RDF) in combination with application of foliar spray of nano urea and urea phosphate management on the yield potential of groundnut presented in Table-1. Result exhibited that application of 100% RDNPK + (0.2% Nano urea + 1 % Urea phosphate) at flowering stage & peg formation stage (T_7) to groundnut produced significantly highest groundnut dry pod yield (2933 kg/ ha), haulm yield (5381 kg/ha) over Control. Treatment T_7 was found at par with T_1 + foliar application of urea @ 2% at 30 & 60 DAS (T_{10}) and T_2 + application of (0.2% Nano urea + 1 % Urea phosphate) at flowering stage and peg formation stage (T_8).

Similar findings were reported by Kannan and Srinivasan (2016), who emphasized that foliar fertilization ensures quick nutrient availability and improves physiological efficiency of crops. The superior growth observed with nano urea application may be due to its smaller particle size and higher surface area, leading to improved nitrogen use efficiency, as also reported by Raliya *et al.* (2018). Nitrogen plays a crucial role in cell division and expansion, which directly affects plant height and biomass production in groundnut (Singh *et al.*, 2004). These results are in conformity with the findings of Duhan and Karwasra (2014), who reported that balanced nitrogen nutrition significantly improved yield components of groundnut. The combined availability of nitrogen and phosphorus through urea phosphate may have further enhanced energy transfer and reproductive growth, resulting in better pod development (Bhatia *et al.*, 2008). The present findings are in agreement with Balasubramanian *et al.* (2004), who reported that improved nitrogen use efficiency leads to higher biomass production and economic yield. Similar yield improvement due to foliar nitrogen application was also reported by Sharma and Prasad (2012), highlighting the importance of efficient fertilizer management for sustainable crop productivity. This observation is supported by Singh *et al.* (2004), who reported that balanced mineral nutrition improves assimilate partitioning in groundnut.

Economics

Data related to economics was presented in Table 2 and figures 3 and 4 revealed that the application of 100% RDNPK + (0.2% Nano urea + 1 % Urea phosphate) at flowering stage & peg formation stage (T_7) to groundnut produced significantly highest groundnut gross returns (Rs.1,81,376/ha), net returns (Rs.1,17,470/ha) and B:C ratio 2.84 over

Control. Treatment T_7 was found at par with T_1 + foliar application of urea @ 2% at 30 & 60 DAS (T_{10}) and T_2 + application of (0.2% Nano urea + 1 % Urea phosphate) at flowering stage & peg formation stage (T_8) in both years of pooled analysis, respectively.

These findings are consistent with Meena *et al.* (2018), who reported that improved nutrient use efficiency enhances profitability while reducing fertilizer losses. The economic advantage of nano urea application has also been emphasized in IFFCO recommendations (IFFCO, 2021), highlighting its potential to reduce conventional nitrogen fertilizer requirement.

Conclusion

Treatment T_7 i.e. application of 100% RDNPK + (0.2% Nano urea + 1 % Urea phosphate) at flowering stage and peg formation stage was recorded highest yield. But, treatment T_8 i.e. application of fertilizer 75% RDNPK + spraying of (0.2% Nano urea + 1 % Urea phosphate) at flowering stage and peg formation stage of groundnut reduced the fertilizer dose by 25% with yield levels at par with T_7. Hence T_8 was found to be the best treatment for saving fertilizers and maximum yields.

References

Balasubramanian, V., Alves, B., Aulakh, M., Bekunda, M., Cai, Z., Drinkwater, L., Mugendi, D. and van Kessel, C. 2004. Crop, environmental, and management factors affecting nitrogen use efficiency. *Agricultural Systems* **79**: 31–55.

Bhatia, V. S., Singh, P., Wani, S. P., Chauhan, G. S., Kesava Rao, A. V. R., Mishra, A. K. and Srinivas, K. 2008. Analysis of potential yields and yield gaps of rainfed groundnut in India. *Agricultural Systems* **96**: 83–91.

Chouriya, A., Choure, A. and Singh, S. 2020. Nano Fertilizers Used for Field Crop in Chhindwara District of Madhya Pradesh. *Indian Journal of Pure and Applied Bioscience* **8**(5): 462-465.

Desai, B. B., Kotecha, P. M. and Salunke, D. K. 1999. Science and Technology of groundnut: Biology, Production, Processing and Utilization, Naya Prakash, Calcutta.

Duhan, B. S. and Karwasra, S. P. S. 2014. Effect of nitrogen and phosphorus on growth and yield of groundnut (*Arachis hypogaea* L.). *Legume Research* **37**(3): 319–322.

IFFCO. 2021. *Nano urea (liquid): Product information and agronomic recommendations.* Indian Farmers Fertiliser Cooperative Limited, New Delhi.

Kannan, R. and Srinivasan, K. 2016. Foliar fertilization for sustainable crop production. *Agricultural Reviews* **37**(2): 119–125.

Malhotra, H., Sharma, V.S. and Pandey, R. 2018. Phosphorus nutrition: plant growth in response to deficiency excess: Inn. Hasanuzzaman, S. *et. al.* (Eds.), Higher Education in the Era of the fourth Industrial Revoluation. Springer Nature, Singapore. pp. 171-190.

Meena, R. S., Meena, V. S., Meena, S. K. and Verma, J. P. 2018. Towards the nutrient management for improving crop productivity and soil fertility.

Journal of Cleaner Production **179**: 337–349.

Mitran, T., Meena, R.S., Lal, R., Layak, J., Kumar, S. and Datta, R. 2018. Role soil phosphorus on soil on legume production. Inn: Meena, R.S. *et. al.* (Eds.), Legume for Soil Health and Sustainable Management, Springer Nature, Singapore. pp. 487-510.

Raliya, R., Saharan, V., Dimkpa, C. and Biswas, P. 2018. Nanofertilizer for precision and sustainable agriculture: Current state and future perspectives. *Journal of Agricultural and Food Chemistry* **66**: 6487–6503.

Sharma, S. N. and Prasad, R. 2012. Efficient fertilizer management for sustainable crop production. *Indian Journal of Fertilisers* **8**(12): 18–31.

Singh, A. L., Basu, M. S. and Singh, N. B. 2004. Mineral nutrition of groundnut. *Indian Journal of Fertilisers* **48**(10): 1147–1153.

Table 1. Effect of nano urea and urea phosphate on growth and yield of summer groundnut (Pooled Data)

	Treatments	Plant height (cm)	Number of branches	Number of pods	Dry Pod Weight (g/plant)	Hundred Kernel Weight (gm)	Shelling %	Sound Mature Kernel %	Hervesting Index %
T_1	100% RDNPK(Control)	31.72	3.73	15.80	12.01	33.11	58.33	88.22	35.47
T_2	75 % RDNPK	30.41	3.53	14.33	11.59	31.44	56.11	87.11	35.65
T_3	50% RDNPK	28.51	3.34	13.93	11.00	27.89	53.39	86.00	34.64
T_4	T_1 + Application of (0.2% Nano urea + 1 % Urea phosphate) at flowering stage	32.27	3.91	17.72	14.83	33.39	60.06	89.22	35.17
T_5	T_2 + Application of (0.2% Nano urea + 1 % Urea phosphate) at flowering stage	31.93	3.79	16.86	14.57	33.11	59.67	88.78	35.61
T_6	T_3 + Application of (0.2% Nano urea + 1 % Urea phosphate) at flowering stage	29.91	3.49	14.10	11.30	29.78	54.55	86.55	35.71
T_7	T_1 + Application of (0.2% Nano urea + 1 % Urea phosphate) at flowering stage & peg formation stage	36.19	4.47	22.69	18.00	36.57	63.72	92.67	35.31
T_8	T_2 + Application of (0.2% Nano urea + 1 % Urea phosphate) at flowering stage & peg formation stage	33.60	4.05	19.33	15.98	34.14	60.83	90.22	35.30
T_9	T_3 + Application of (0.2% Nano urea + 1 % Urea phosphate) at flowering stage & peg formation stage	30.53	3.61	14.72	11.82	31.72	56.19	87.56	37.09
T_{10}	T_1 + Foliar application of urea @ 2% at 30 & 60 DAS	34.11	4.15	21.12	16.72	34.56	62.11	91.00	35.21
	SE+	1.24	0.17	1.45	0.90	0.90	1.19	1.22	
	CD (P-0.05)	3.69	0.52	4.30	2.65	2.68	3.54	3.63	
	CV (5 %)	6.80	7.99	13.77	10.47	4.74	3.55	2.39	

Table 2. Effect of nano urea and urea phosphate on yield and economics of summer groundnut (Pooled Data)

	Treatments	Dry pod yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Kernels yield (kg ha^{-1})	Gross monetary returns (Rs ha^{-1})	Cost of cultivation (Rs ha^{-1})	Net returns (Rs ha^{-1})	B:C ratio
T_1	100% RDNPK(Control)	2338	4257	1363	144535	60606	83930	2.38
T_2	75 % RDNPK	1989	3604	1119	122942	59899	63043	2.05
T_3	50% RDNPK	1504	2877	803	93137	59193	33944	1.57
T_4	T_1 + Application of (0.2% Nano urea + 1 % Urea phosphate) at flowering stage	2432	4484	1461	150423	62256	88168	2.42
T_5	T_2 + Application of (0.2% Nano urea + 1 % Urea phosphate) at flowering stage	2375	4309	1417	146822	61549	85273	2.39
T_6	T_3 + Application of (0.2% Nano urea + 1 % Urea phosphate) at flowering stage	1928	3491	1052	119180	60843	58337	1.96
T_7	T_1 + Application of (0.2% Nano urea + 1 % Urea phosphate) at flowering stage & peg formation stage	2933	5381	1869	181376	63906	117470	2.84
T_8	T_2 + Application of (0.2% Nano urea + 1 % Urea phosphate) at flowering stage & peg formation stage	2617	4859	1591	161923	63199	98724	2.56
T_9	T_3 + Application of (0.2% Nano urea + 1 % Urea phosphate) at flowering stage & peg formation stage	2121	3666	1194	130927	63743	67184	2.05
T_{10}	T_1 + Foliar application of urea @ 2% at 30 & 60 DAS	2693	4952	1673	166528	61686	104842	2.70
	SE+	153.91	296.95	99.81	-	-	-	-
	CD (P-0.05)	456.89	882.05	296.94	-	-	-	-
	CV (5 %)	11.59	12.83	12.91	-	-	-	-

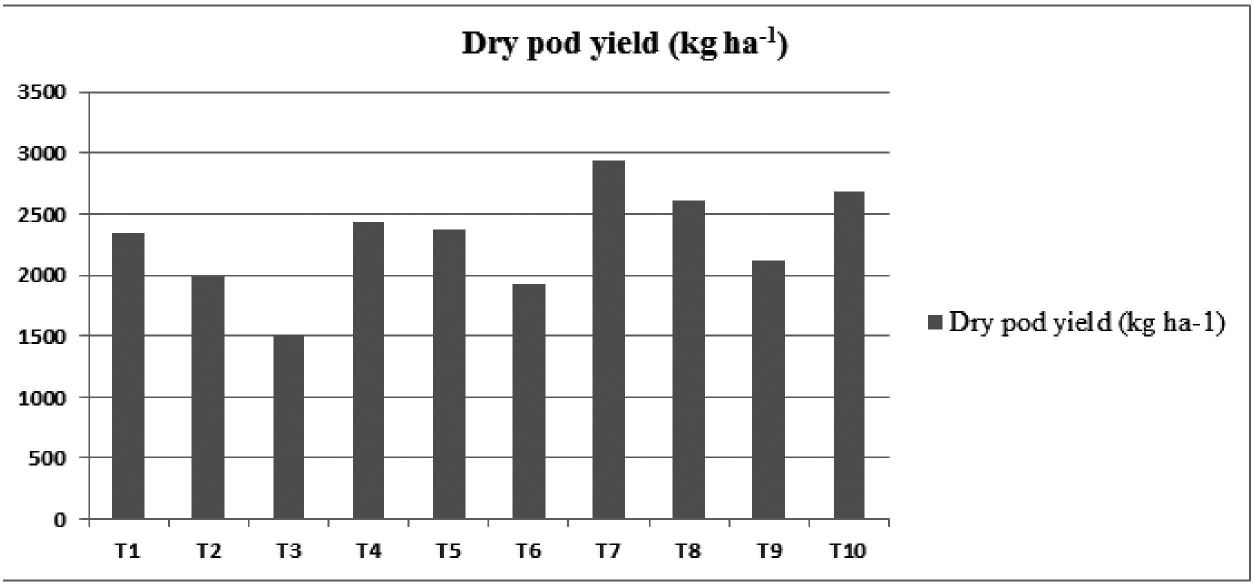

Figure 1. Effect of nano urea and urea phosphate with RDF on pod yield of groundnut crop (Pooled basis)

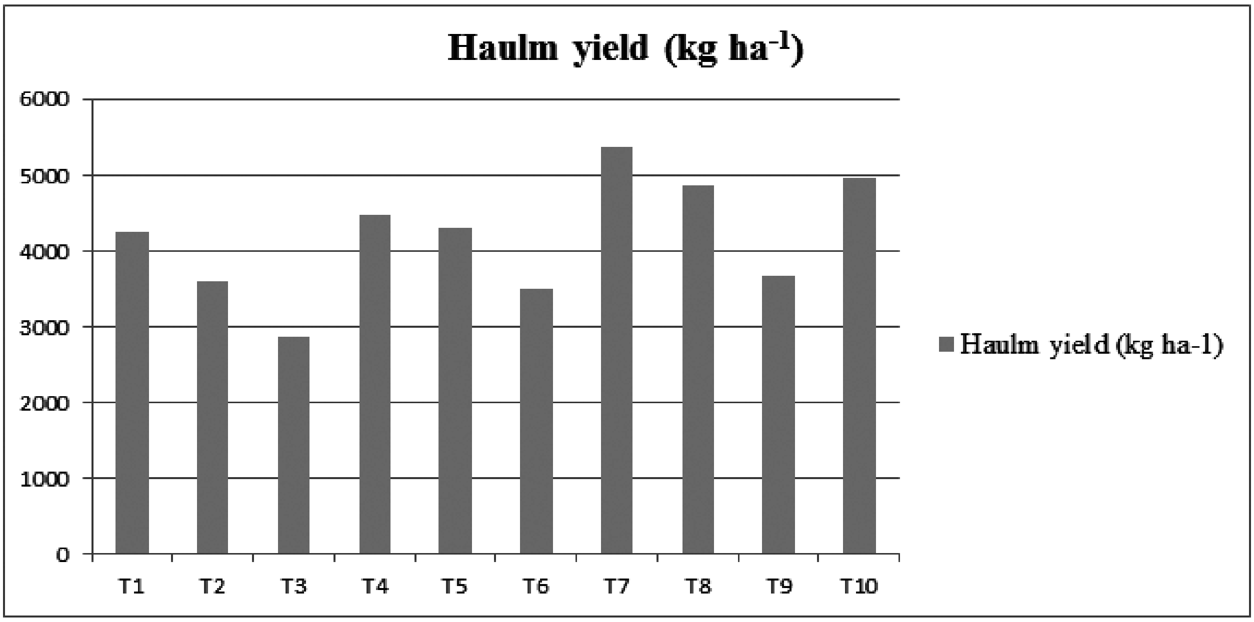

Figure 2. Effect of nano urea and urea phosphate with RDF on haulm yield of groundnut crop (Pooled basis)

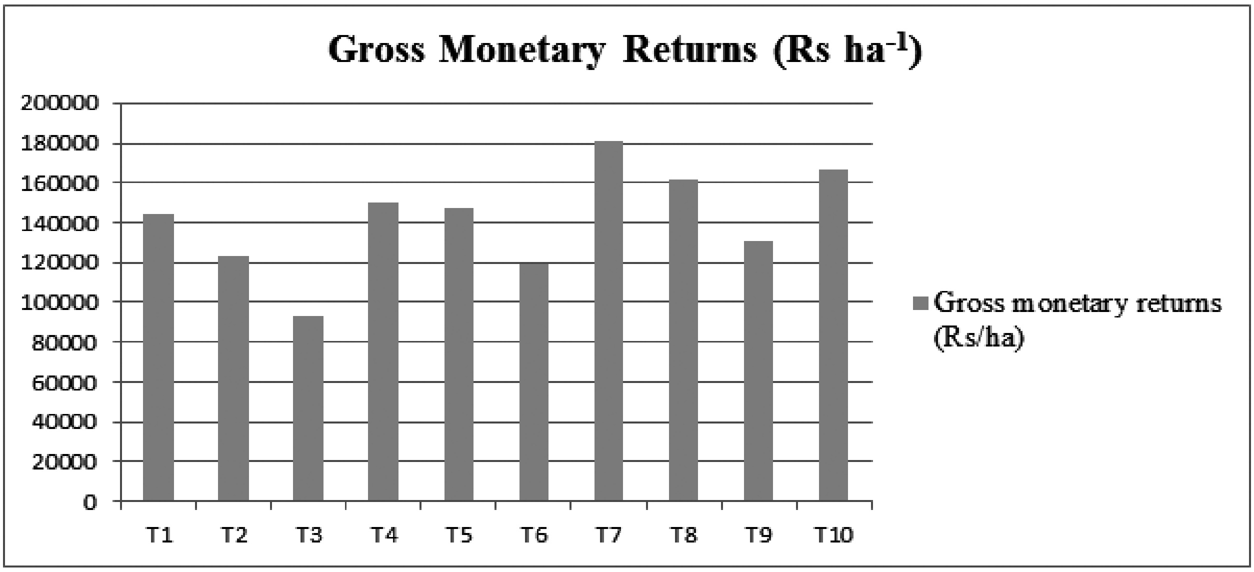

Figure 3. Effect of nano urea and urea phosphate with RDF on Gross Monetary Returns of groundnut crop (Pooled basis)

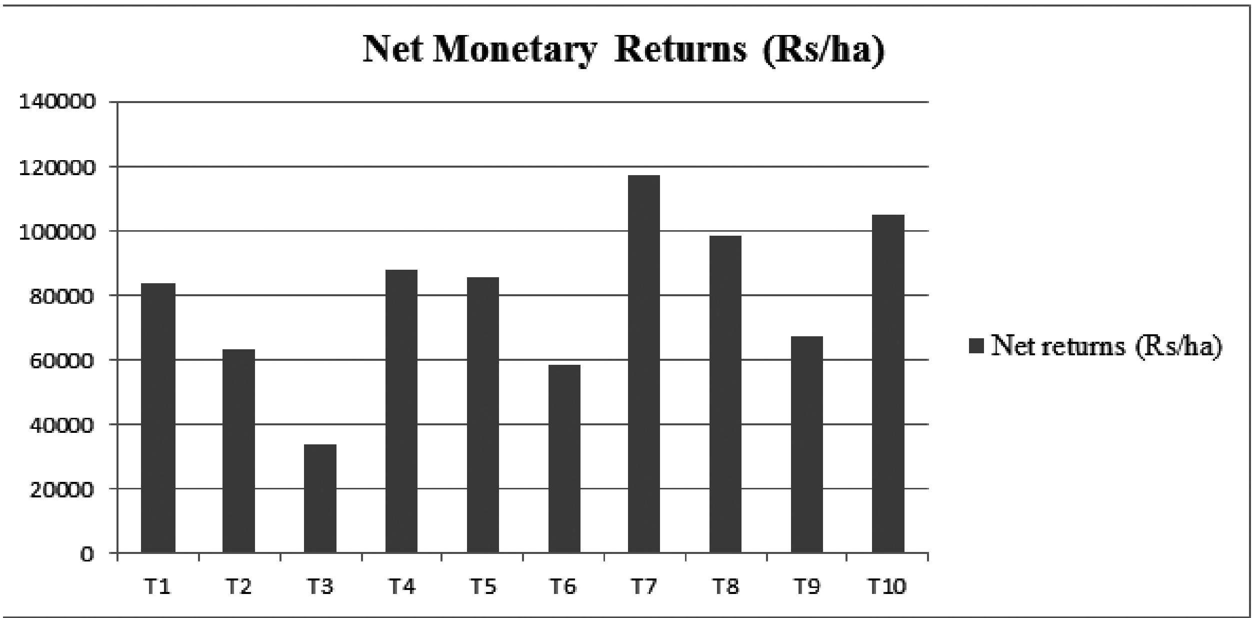

Figure 4. Effect of nano urea and urea phosphate with RDF on Net Monetary Returns of groundnut crop (Pooled basis)