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EFFECT OF NANO-DAP ON QUALITY, CONTENT AND UPTAKE OF BLACK GRAM (*VIGNA MUNGO* L.) IN INCEPTISOL

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ABSTRACT

The field experiment was carried out on "Effect of Nano-DAP on Quality, nutrient availability, uptake, and content in black Gram (*Vigna mungo* L.) grown in Inceptisol", during *Kharif* season of year, 2023-24 at research field, Department of Soil Science. College of Agriculture, Latur. The experiment was laid out in RBD with three replications and recommended variety of black gram TAU-1 as a test crop along with nine treatments. The results in nutshell indicated that the quality, content and nutrient uptake were significantly influenced by application of 100 per cent RDNP + S.T. of Nano-DAP+ F.A.@ 0.4 per cent of Nano- DAP at 20, 30 & 40 DAS. The growth parameters *viz*., plant height, number of branches, leaf area, no. of nodules plant^{-1} were significantly increased with application of 100 per cent RDNP + S.T. of Nano-DAP+ F.A @ 0.4 per cent of Nano- DAP at 20, 30 & 40 DAS (T_9) which was found at par with treatment T_8 (100 per cent RDNP + S.T. of Nano-DAP+ F.A.@ 0.4 per cent of Nano-DAP at 20 & 30 DAS), T_2 (100 per cent RDF + S.T. of Nano-DAP) and T_7 (75 per cent RDNP + S.T. of Nano-DAP+ F.A.@ 0.4 per cent of Nano-DAP at 20, 30 & 40 DAS). The improvement in quality parameters were recorded with application of (100 per cent RDNP + S.T. of Nano-DAP+ F.A @ 0.4 per cent of Nano-DAP at 20, 30 & 40 DAS) (T_9) *i.e.,* Test weight, protein content, protein yield was increased significantly followed by treatments T_8 (100 per cent RDNP + S.T. of Nano-DAP+ F.A.@ 0.4 per cent of Nano-DAP at 20 & 30 DAS) and T_2 (100 % RDF + S.T. of Nano-DAP). Uptake of N, P, K in black gram was increased significantly with treatment T_9 (100 per cent RDNP + S.T. of Nano-DAP+ F.A@ 0.4 per cent of Nano-DAP at 20, 30 & 40 DAS)
***Keywords*: **Black gram, Nano-DAP, Foliar application.

Introduction

Black gram (*Vigna mungo* L.) being a legume, it enriches soil N content and has relatively a short (70-75 days) life. Black gram is a perfect combination of all nutrients which include 20 to 25% of proteins, 40 to 47% of starch along with ash, fats, carbohydrates and essential vitamins. It is boiled and eaten directly or used after splitting into dal. It is extensively used in various culinary preparations like idli, dosa, uttapam etc and recommended for diabetes. The low availability of nitrogen and phosphorous causes the reduction in chlorophyll content, poor root growth, and thereby decrease in yield of crop. This crop has great importance due to short duration, high yielding and quick growing crop. Green tender pods are used as vegetable (Gupta 2001). The United Nations declared 2016 as “International Year of Pulses” (IYP) to highlight public awareness of the nutritional benefits of pulses as part of sustainable food production aimed at food security and nutrition (Mohanty and Satyasai, 2015).

Nano-DAP is an efficient source of available nitrogen (N) and phosphorus (P_2O_5) for all the crops and helps in correcting the nitrogen & phosphorus deficiencies in standing crops. Nano-DAP formulations contains nitrogen (8.0% N w/v) and phosphorus (16.0% P_2O_5 w/v). Nano-DAP (Liquid) has an advantage in terms of surface area to volume as its particle size is less than 100 nano meter (nm). This unique property enables is to enter easily inside the seed surface or through stomata and other plant openings nano clusters of nitrogen and phosphorus in Nano-DAP are functionalized with bio-polymers and other excipients. Better spread ability and assimilation of Nano-DAP inside the plant system leads to higher seed vigor, more chlorophyll, photosynthetic efficiency better quality and an increase in crop yields.

Nano scale fertilizers have the potential to act as a catalyst for plant growth and can enhance the exchange of plant gases and root efficiency. Furthermore, due to the slowness and control of nutrient release, nano fertilizers are able to increase the availability of nutrients in the root zone (De Rosa, *et al*., 2010) Newly developed Nano-fertilizers by using nanotechnology are smaller in size, with large surface area leading to increase in absorption capacity and controlled-release kinetics to targeted sites. (Rameshaiah *et al*., 2015)

Material and Methods

The field experiment was carried out during during *Kharif* season of year, 2023-24 at research field, Department of Soil Science. College of Agriculture, Latur.to study the "Effect of Nano-DAP on growth and yield of black gram (*Vigna mungo* L.) in Inceptisol**"**, The soil was black with clayey in texture, slightly alkaline in reaction having pH (7.60), low in available nitrogen (178.55 kg ha^{-1}), low in available phosphorus (11.98 kg ha^{-1}), medium in available potassium (300.45 kg ha^{-1}) and field topography was uniform levelled, well drained and favorable for optimum crop growth. This data indicated that mean maximum temperature during crop growth period is 32.34°C while the mean minimum temperature is 20.10°C. The mean humidity during morning is 83.69 % while mean humidity during evening is 34.09 %.

The experiment was laid out in randomized block design with three replications and nine treatments. The treatment includes T1 – Control, T2 - (100 % RDF + S.T of Nano-DAP), T3 -(S.T of Nano-DAP + F.A.@ 0.4% of Nano-DAP at 20, 30 & 40 DAS), T4 - (50 % RDNP + S.T of Nano-DAP + F.A.@ 0.4% of Nano-DAP at 20 & 30 DAS), T5 - (50 % RDNP + S.T of Nano-DAP + F.A.@ 0.4% of Nano-DAP at 20, 30 & 40 DAS), T6 - (75 % RDNP + S.T of Nano-DAP + F.A.@ 0.4% of Nano-DAP at 20 & 30 DAS), T7-(75 % RDNP + S.T of Nano-DAP + F.A.@ 0.4% of Nano-DAP at 20, 30 & 40 DAS), T8 - (100 % RDNP + S.T of Nano-DAP + F.A.@ 0.4% of Nano-DAP at 20 & 30 DAS),T9 – (100 % RDNP + S.T of Nano-DAP + F.A.@ 0.4% of Nano-DAP at 20, 30 & 40 DAS)

The plot size of each experimental unit was 3.9 m x 4m. Sowing was done by drilling method on 06 th July, 2023 at spacing of 30 x 10 cm. The recommended cultural practices and plant protection measures were undertaken. The recommended dose of fertilizer 25:50:25 NPK kg ha^{-1} was applied as per treatments. The foliar application of Nano-DAP and Seed treatment of Nano-DAP were taken as per the treatments and applied before sowing the seed. The crop was harvested on 4th September 2023

Quality parameter

Test weight

After drying of seed sample one thousand seed was counted from each net plot and weight was recorded.

Protein content and protein yield

It was determined by estimating nitrogen content in the seed and multiplied by 6.25 (AOAC, 1975). By using protein percentage in black gram protein yield kg ha^{-1} was calculated as below.

$$\text{Protein yield (kg ha}^{-1}) = \frac{\text{Seed yield (kg ha}^{-1}) \times \text{Protein content in seed (\%)}}{100}$$

Method of plant extraction

One gram fine powdered sample of straw and grain, 15 ml of di-acid mixture (H_2SO_4:$HClO_4$ in the ration of 5:1) added and digested the straw and grain sample. After completion of extract this extract were used for determination of various nutrients (Piper, 1966).

Nitrogen

Total nitrogen in plant was determined by micro Kjeldahl's method (Jackson, 1973).

Phosphorus

Total phosphorus in dry matter was determined by Vanadomolybdate phosphoric acid yellow colour method (Jackson, 1973).

Potassium

Potassium content in plant sample was determined on Flame Photometer as suggested by Jackson (1973).

Uptake of nutrients

The uptakes nutrients by green gram crop were calculated by using following formula.

$$\text{Uptake of Nutrients (kg ha}^{-1}) = \frac{\text{Nutrient content (\%)} \times \text{seed and stover yield ha}^{-1}}{100}$$

Result and Discussion

Quality Parameters

Test weight (g)

The findings regarding the combined effect varied levels of fertilizer applications and foliar spray of Nano-DAP on test weight of black gram are presented in table 1 and fig 2 The test weight of black gram seed was influenced significantly due to foliar spray of Nano-DAP and was ranged between 37.96 to 39.46 g.

From the data observed that the maximum test weight (39.46 g) was recorded in treatment T_9 (100 per cent RDNP + S.T. of Nano-DAP + F.A @ 0.4 per cent of Nano-DAP at 20, 30 & 40 DAS) which was numerically superior over rest of the treatments as followed by treatment T_8 (100 per cent RDNP + S.T. of Nano-DAP + F. A @0.4 per cent of Nano-DAP at 20 & 30 DAS) and T_2 (100 per cent RDF + S.T. of Nano-DAP) i.e., (39.42) and 39.40 However, the lowest test weight (37.96 g) was noticed in treatment T_1 (control). These findings are agreement with close of Sharifi *et al.* (2018) and Dikey *et al.* (2020)

Protein content and protein yield

The data on protein content and protein yield of black gram as influenced by varied levels of fertilizer application and foliar spray of Nano DAP are presented in table 1 and fig 1. Both the quality parameters were significantly influenced by different treatments. The Protein content and protein yield of black gram varied between 21.71 to 22.43 per cent and 143.8 kg ha^{-1} to 282.6 kg ha^{-1}, respectively.

From the data it was observed that the treatment T_9 (100 per cent RDNP + S.T + F.A @0.4 per cent of Nano-DAP at 20, 30 & 40 DAS) recorded maximum protein content (22.43 per cent) which was numerically superior over rest of the treatments followed by treatment T_8 (100 per cent RDNP + S.T. of Nano-DAP + F.A @ 0.4 per cent of Nano-DAP at 20 and 30 DAS), T_2 (100 per cent RDF + S.T. of Nano-DAP) and treatment T_7 (75 per cent RDNP + S.T of Nano-DAP+ F.A @0.4 per cent of Nano-DAP at 20, 30 & 40 DAS) *i.e.* 22.42, 22.40 and 22.33 per cent respectively. Significantly maximum protein yield (282.6 kg ha^{-1}) was obtained in treatment T_9 which was found at par with treatment T_8 (268.97 kg ha^{-1}), T_2 (266.20 kg ha^{-1}) while lowest protein content (21.71 per cent) protein yield (143.86 kg ha^{-1}) was recorded in treatment T_1 (control). These results are in agreement with result of Devi *et al.* (2012) and Krishna *et al.* (2018)

Effect of foliar application Nano-DAP on content and uptake of nutrients by black gram.

1) Nitrogen content and uptake by black gram

The data on nitrogen content and uptake by black gram as influenced by application of varied levels of fertilizers doses along with foliar spray of Nano-DAP presented in (Table 2 and Fig.3) From the data it was observed that the nitrogen content in grain and straw was ranged between 2.40 to 3.38 per cent and 0.53 to 1.32 per cent respectively. Similarly, the uptake of nitrogen by grain and straw was varied from 23.02 to 45.22 kg ha^{-1} and 6.21 to 25.92 kg ha^{-1}, respectively.

The substantially increased nitrogen content and uptake by grain (3.38 % and 45.22 kg ha^{-1}) and straw (1.32 % and 25.92 kg ha^{-1}) was recorded in treatment T_9 (100 per cent RDNP + S.T. of Nano-DAP + F.A @ 0.4 per cent of Nano-DAP at 20, 30 & 40 DAS). However, the treatment T_9 was noted at par with the treatment T_8 (100 per cent RDNP + S.T. of Nano-DAP + F.A @ 0.4 per cent of Nano-DAP at 20 & 30 DAS) (3.33 %, 43.04 kg ha^{-1}) in grain and (1.27 % and 24.37 kg ha^{-1} in straw) and T_2 (100 per cent RDF + S.T. of Nano-DAP) (3.31 %, 42.62 kg ha^{-1}) in grain and (1.22 % and 24.19 kg ha^{-1} in straw) The lower values of nitrogen content and uptake in grain (2.40 % and 23.02 kg ha^{-1}) and straw (0.53 % and 6.21 kg ha^{-1}) of black gram was noticed in treatment T_1 (control). Similarly, significantly higher total uptake of nitrogen (71.14 kg ha^{-1}) was found in treatment T_9 but it was noted at par with the treatment T_8 (67.41 kg ha^{-1}) and T_2 (66.81) respectively. The lowest total uptake nitrogen (29.23 kg ha^{-1}) was noted in treatment T_1 control. Nearly similar results were found by Paikra *et al.* (2018) and Lyngdoh *et al.* (2019)

2) Phosphorous content and uptake by black gram.

Data about the different fertilizer application levels combined with the foliar application of Nano-DAP is shown in (Table 3 and fig 4). The results demonstrated that different treatments of Nano-DAP fertilizer had a substantial impact on the content and uptake of phosphorous. According to the statistics, grain and straw had phosphorus contents that varied from 0.44 to 0.73 per cent and 0.17 to 0.36 per cent, respectively. Similar variations were seen in the phosphorus uptake by grain and straw, which ranged from 4.18 to 9.56 kg ha^{-1} and 2.24 to 7.15 kg ha^{-1}, respectively.

The significant higher phosphorus content from grain and straw (0.73 and 0.36 %) was noticed in treatment T_9 (100 per cent RDNP + S.T. of Nano-DAP + F.A @0.4 per cent of Nano-DAP at 20, 30 & 40 DAS). However, it was found at par with treatments T_8 (100 per cent RDNP+ S.T. of Nano-DAP + F.A @0.4 per cent of Nano-DAP at 20 & 30 DAS), 0.69, 0.32 per cent in grain and straw respectively. The significantly lowest content and uptake of phosphorus was recorded in grain and straw with treatment T_1 (0.44 and 0.17 %). The substantially increased phosphorus uptake by grain

(9.56 kg ha^{-1}) and straw (7.15 kg ha^{-1}) was recorded in treatment T_9 (100 per cent RDNP + S.T. of Nano-DAP + F.A @ 0.4 per cent of Nano-DAP at 20, 30 & 40 DAS). However, the treatment T_9 was noted at par with the treatment T_8 (100 per cent RDNP + S.T. of Nano-DAP + F. A @ 0.4 per cent of Nano-DAP at 20 & 30 DAS) and T_2 (100 per cent RDNP + S.T. of Nano-DAP) *i.e* (8.91, 6.21) and (8.72, 6.15) by grain and straw, respectively. Similarly, significantly higher total uptake of phosphorus (16.71 kg ha^{-1}) was found in treatment T_8 but it was noted at par with the treatment T_8 (15.01 kg ha^{-1}) and T_2 (14.87) respectively. The lowest total uptake nitrogen (6.42 kg ha^{-1}) was noted in treatment T_1 control. This result is agreed with the findings of Paikra *et al.* (2018) and Lyngdoh *et al.* (2019)

3) Potassium content and uptake by black gram

The data on potassium content in grain and straw and total uptake is depicted in (Table 4 and fig 5). It was seen from the data that the content and uptake of potassium was influenced remarkably due to varied levels of fertilizer application along with the foliar application of Nano-DAP by grain varied from (1.22 to 1.74 %) and by straw (ranges from 0.42 to 0.79 %). The uptake of potassium in grain and straw was varied from 9.98 to 23.17 kg ha^{-1} and 6.11 to 15.0 kg ha^{-1}, respectively.

The potassium content in seed and straw was increased considerably with the foliar application of Nano-DAP fertilizer but not reached to its level of significance. Among the different treatments T_9 (100 per cent RDNP + S.T + F.A @0.4 per cent of Nano-DAP at 20, 30 & 40 DAS) recorded maximum potassium content in grain (1.74 %) and by straw (0.79 %). While minimum values of potassium content in seed (1.22%) and straw (0.42%) was found in treatment T_1 (control). As compared to the treatment T_1 the potassium content in both grain and straw was slightly increased in the remaining all treatments. further data indicated that uptake of potassium was significantly increased in seed (23.17 kg ha^{-1}) and straw (15.0 kg ha^{-1}) with the application of treatment T_9 and was found at par with treatment T_8 (22.08 kg ha^{-1} and 14.17 kg ha^{-1}) and T_2 (21.0 kg ha^{-1} and 13.50 kg ha^{-1}) Whereas, the lowest potassium uptake was reported in both grain (9.98 kg ha^{-1}) and straw (6.11 kg ha^{-1}) was noticed in treatment T_1 (control) compared to other treatments

Conclusion

Quality parameters such as protein yield of black gram was noted maximum with application of (100 per cent RDNP+ S.T. of Nano-DAP with foliar application of Nano-DAP @ 0.4 % at 20, 30 & 40 DAS) which was found at par with application of (100 per cent RDNP+ S.T. of Nano-DAP with foliar application of Nano-DAP @ 0.4 % at 20 & 30 DAS) and (100 per cent RDNP+ S.T. of Nano-DAP) of black gram but parameters such as test weight and protein content does not reached to its level of significance with the applications of different levels of fertilizers along with foliar application of Nano DAP.

The maximum uptake of N, P and K was found in black gram with the application of 100 per cent RDNP+ S.T. of Nano-DAP with foliar application of Nano- DAP @ 0.4 % at 20, 30 & 40 DAS. Which was found at par results recorded with application of (RDNP @ 100 per cent + S.T. of Nano-DAP with two foliar applications of Nano-DAP@ 0.4 per cent at 20 & 30 DAS), (RDF @ 100 per cent with S.T. of Nano-DAP) of black gram.

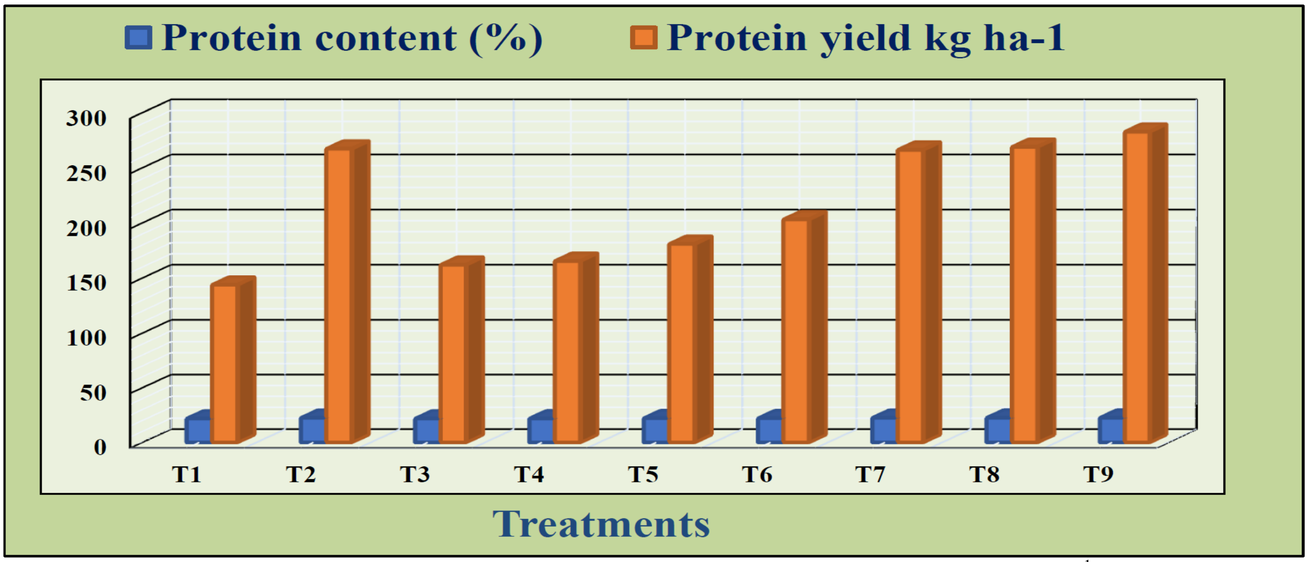

Fig. 1: Effect of foliar application of Nano-DAP on protein content (per cent), protein yield (kg ha^{-1}) of black gram.

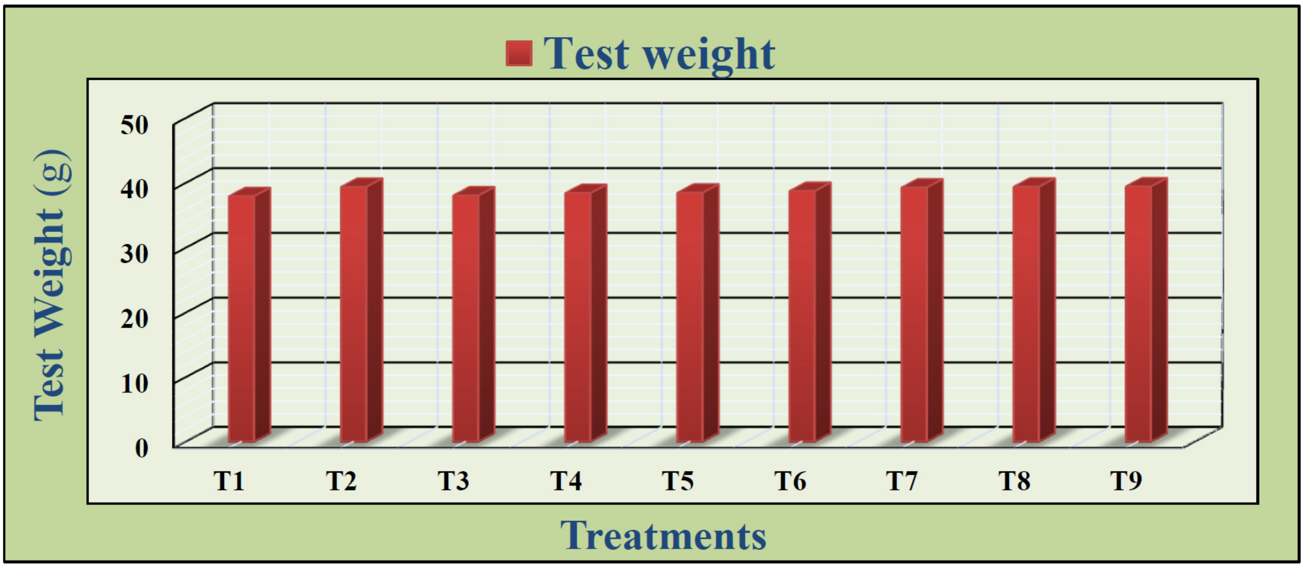

Fig. 2: Effect of foliar application of Nano-DAP on test weight of black gram.

Table 1: Effect of foliar application of Nano-DAP on protein content (per cent), protein yield (kg ha^{-1}) and test weight of black gram

Treatments Details	Protein		Test weight (g)
	Protein Content (%)	Protein Yield (kg ha^{-1})	
T_1: Control	21.71	143.8	37.96
T_2: 100% RDF + S.T. of Nano-DAP.	22.41	267.22	39.40
T_3: S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20,30 & 40 DAS.	21.73	161.94	38.07
T_4: 50 % RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20 &30 DAS	21.84	165.42	38.44
T_5: 50 % RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20,30 & 40 DAS	22.05	180.83	38.49
T_6: 75% RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20 & 30 DAS	22.04	203.14	38.75
T_7: 75% RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20,30 & 40 DAS	22.40	266.22	39.30
T_8: 100% RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20 & 30 DAS	22.42	268.92	39.42
T_9: 100% RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20, 30 & 40 DAS	22.43	282.6	39.46
SE±	0.23	5.40	0.50
CD at 5%	**NS**	16.19	**NS**

Table 2: Effect of foliar application of Nano-DAP on content (%) and uptake of N (Kg ha^{-1}) by seed and straw of black gram after harvest.

Treatments	N Content (%)		N Uptake (kg ha^{-1})		Total uptake (kg ha^{-1})
	Seed	Straw	Seed	Straw	
T_1: Control	2.40	0.53	23.02	6.21	29.23
T_2: 100% RDF + S.T. of Nano-DAP.	3.31	1.22	42.62	24.19	66.81
T_3: S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20,30 & 40 DAS.	2.60	0.60	25.92	8.41	34.32
T_4: 50 % RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20 &30 DAS	2.62	0.62	26.48	8.71	35.19
T_5: 50 % RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20,30 & 40 DAS	2.73	0.76	28.93	11.83	40.76
T_6: 75% RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20 & 30 DAS	2.83	0.85	32.51	13.63	46.14
T_7: 75% RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20,30 & 40 DAS	3.06	0.97	36.42	16.72	53.14
T_8: 100% RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20 & 30 DAS	3.33	1.27	43.04	24.37	67.41
T_9: 100% RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20, 30 & 40 DAS	3.38	1.32	45.22	25.92	71.14
SE±	0.03	0.04	1.00	0.58	1.45
CD at 5%	0.09	0.13	3.02	1.74	4.36

Table 3: Effect of foliar application of Nano-DAP on content (%) and uptake of P (kg ha^{-1}) by seed and straw of black gram after harvest

Treatments	P Content (%)		P Uptake (kg ha^{-1})		Total uptake (kg ha^{-1})
	Seed	Straw	Seed	Straw	
T_1: Control	0.44	0.17	4.18	2.24	6.42
T_2: 100% RDF + S.T. of Nano-DAP.	0.64	0.28	8.72	6.15	14.87
T_3: S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20,30 & 40 DAS.	0.46	0.18	4.57	2.53	7.10
T_4: 50 % RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20 &30 DAS	0.49	0.20	4.95	2.80	7.75
T_5: 50 % RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20,30 & 40 DAS	0.51	0.21	5.37	3.21	8.58
T_6: 75% RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20 & 30 DAS	0.56	0.22	6.41	3.55	9.96
T_7: 75% RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20,30 & 40 DAS	0.60	0.25	8.52	6.04	14.56
T_8: 100% RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20 & 30 DAS	0.69	0.32	8.91	6.21	15.01
T_9: 100% RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20, 30 & 40 DAS	0.73	0.36	9.56	7.15	16.71
SE±	0.018	0.02	0.33	0.36	0.64
CD at 5%	0.054	0.06	1.00	1.09	1.92

Table 4: Effect of foliar application of Nano-DAP on content (%) and uptake of K (kg ha^{-1}) by seed and straw of black gram after harvest.

Treatments	K Content (%)		K Uptake (kg ha^{-1})		Total uptake (kg ha^{-1})
	Seed	Straw	Seed	Straw	
T_1: Control	1.22	0.42	9.98	6.11	16.09
T_2: 100% RDF + S.T. of Nano-DAP.	1.57	0.72	21	13.76	34.76
T_3: S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20,30 & 40 DAS.	1.28	0.45	12.69	6.25	18.94
T_4: 50 % RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20 &30 DAS	1.30	0.47	13.09	6.63	19.72
T_5: 50 % RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20,30 & 40 DAS	1.36	0.52	14.36	8.02	22.38
T_6: 75% RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20 & 30 DAS	1.45	0.56	16.62	9.01	25.63
T_7: 75% RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20,30 & 40 DAS	1.51	0.66	17.94	10.73	28.67
T_8: 100% RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20 & 30 DAS	1.63	0.62	22.08	14.17	36.25
T_9: 100% RDNP + S.T. of Nano-DAP +F.A.@ 0.4% of Nano-DAP at 20, 30 & 40 DAS	1.74	0.79	23.17	15.0	38.17
SE±	0.11	0.03	0.75	0.54	1.17
CD at 5%	NS	NS	2.26	1.62	3.53

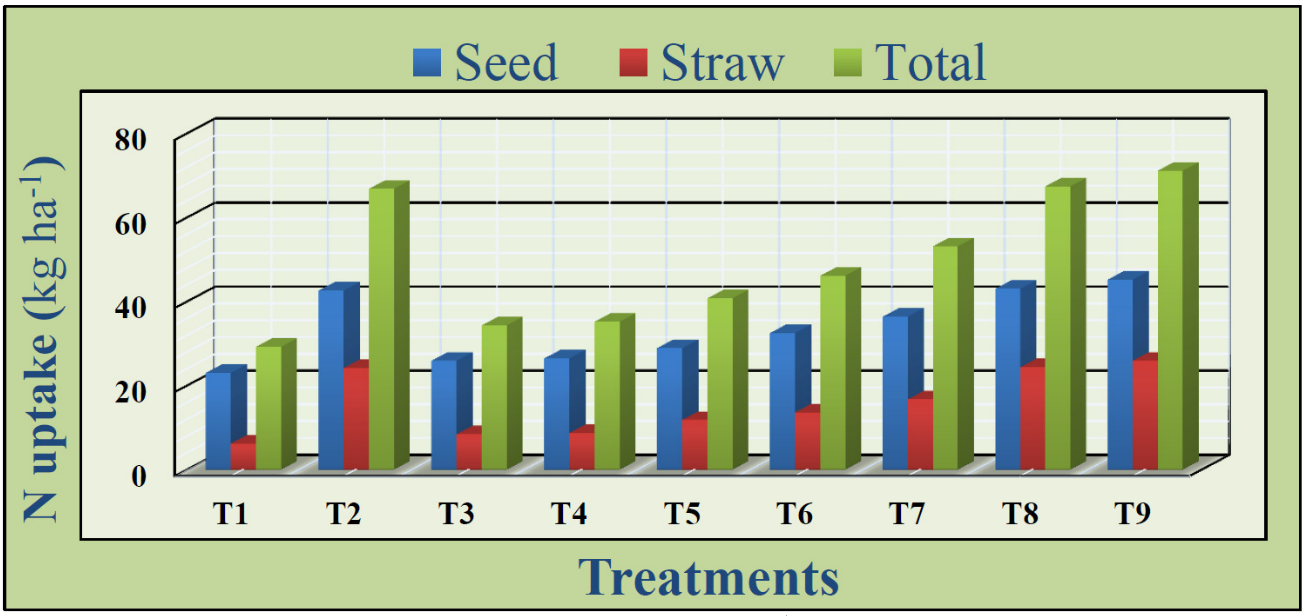

Fig. 3 : Effect of foliar application of Nano-DAP on uptake of N (kg ha^{-1}) by seed and straw of black gram after harvest

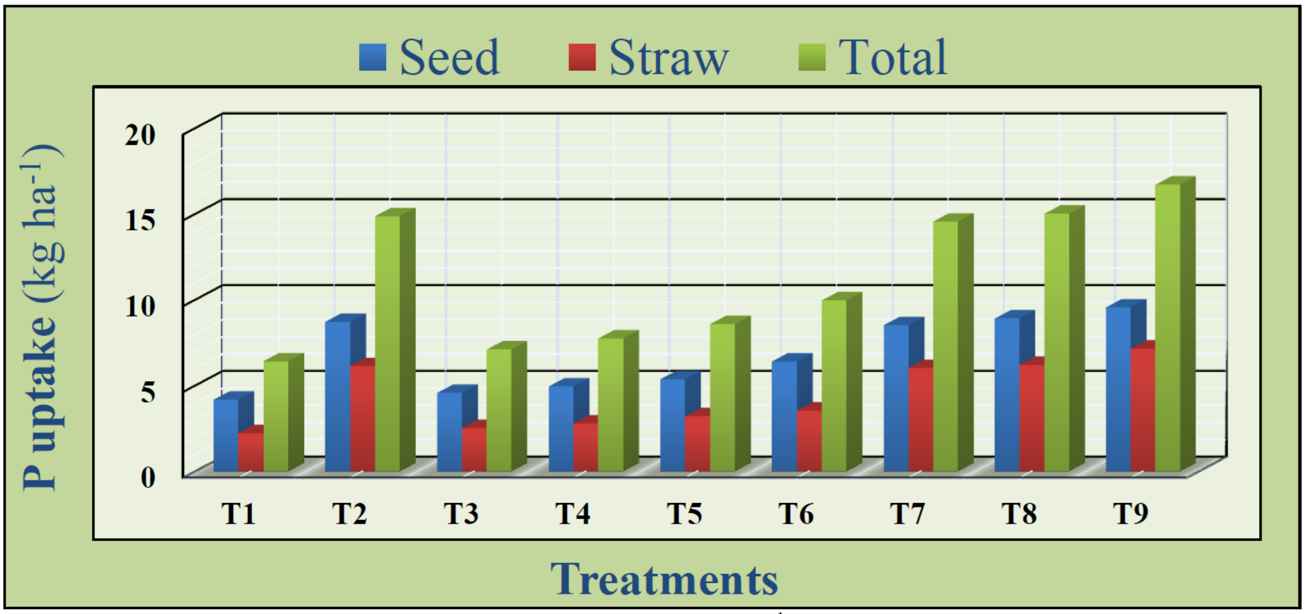

Fig. 4: Effect of foliar application of Nano-DAP on uptake of P (kg ha^{-1}) by seed and straw of black gram after harvest

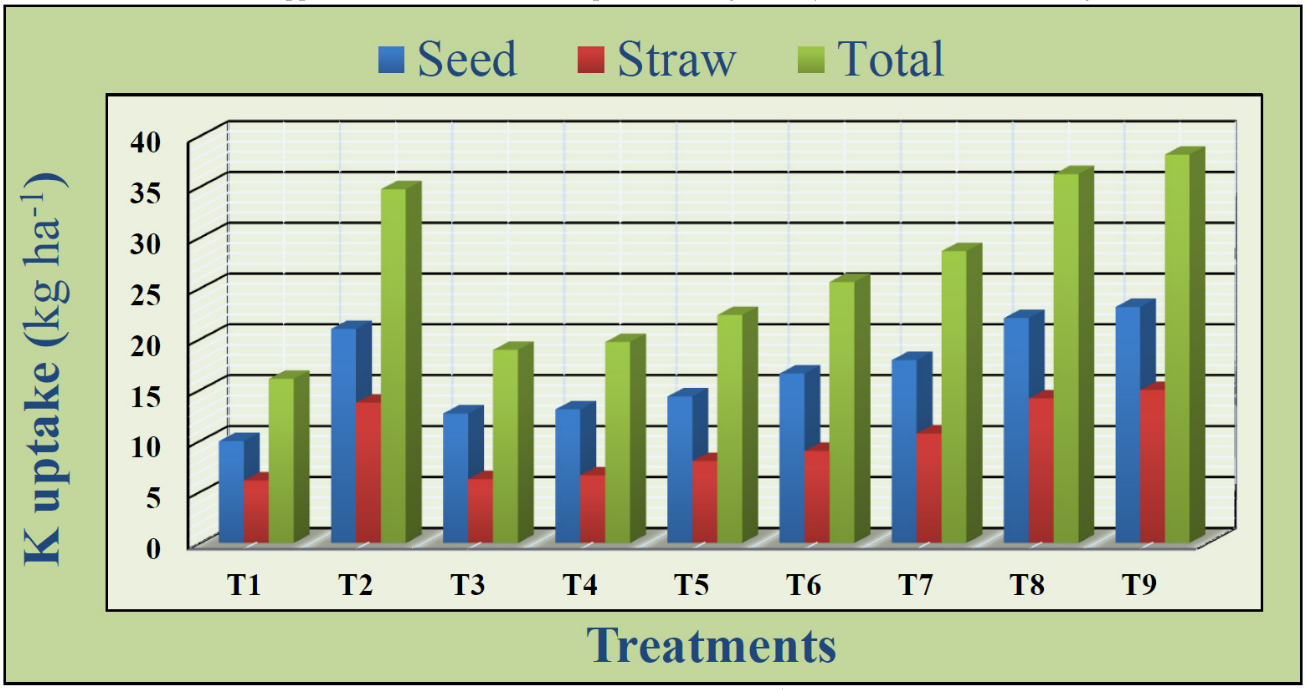

Fig. 5: Effect of foliar application of Nano-DAP on uptake of K (kg ha^{-1}) by seed and straw of black gram after harvest

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