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EFFECT OF INTEGRATED APPLICATION OF ORGANIC MANURES AND INORGANIC FERTILIZERS ON GROWTH AND BIOMASS PRODUCTIVITY OF MACHINE SOWN GROUNDNUT

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ABSTRACT

A field experiment was conducted in the farmer's field at Arasampalayam village, Rasipuram (Tk.), Namakkal (Dt.), Tamil Nadu during May-Sep, 2021 (Vaigasipattam) to study the effect of integrated nutrient management on growth and biomass productivity of machine sown groundnut. The experiment was laid out in a Randomized Block Design (RBD) and replicated thrice with 10 treatments. The treatments consisted of T_0 – Absolute control (No organics and inorganics), T_1 – RDF through inorganic fertilizers (25:50:75 Kg N, P_2O_5, K_2O ha^{-1}), T_2 – 75% RDN + 25% N on equivalent basis of EFYM, T_3 – 50% RDN + 50% N on equivalent basis of EFYM, T_4 –75% RDN + 25% N on equivalent basis of poultry manure compost, T_5 – 50% RDN + 50% N on equivalent basis of poultry manure compost, T_6 – T_2 + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS, T_7 – T_3 + Foliar application of salicylic acid @100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS, T_8 – T_4 + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS, T_9 – T_5 + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS. The results of this experiment showed that combined application of 75% RDN + 25% N on equivalent basis of poultry manure compost + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS recorded highest growth parameters *viz*., plant height, number of compound leaves plant^{-1}, leaf area index (LAI), number of nodules plant^{-1}and dry matter production (DMP) recorded with significantly higher values.
Keywords: Integrated, EFYM, Poultry manure compost, Salicylic acid, TNAU groundnut rich, RDN

Introduction

Groundnut or Peanut (*Arachis hypogaea* L.) is known as "King of Oilseeds", which belongs to Legume family (Fabaceae). Groundnut is also called as Earthnuts, Monkey nuts, Wonder nut and Poor man's cashew nut. Groundnut is a multipurpose crop providing edible oil (44-50%), vegetable protein (26%), carbohydrates (20%) and fibre (5%).Groundnut are grown on 30.00 million hectares around the world with an annual yield of 50.25 million metric tonnes and productivity of 1.67 metric tonnes ha^{-1} annually. India ranks first inthe world's groundnut area (6.02 m. ha), production (6.70 million metric tonnes) and with the productivity (1.11 t ha^{-1}) during 2020 - 2021 (USDA, 2022). In India, the groundnut production is mostly concentrated in Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Rajasthan. In Tamil Nadu, groundnut is cultivated with an area of 4.09 lakh ha, production of 10.23 lakh tonnes and productivity of 2502 kg ha^{-1} during 2020 – 2021 (Indiastat, 2022).

The average yield of groundnut in India is extremely low due to cultivation of groundnut mainly under rainfed conditions, biotic and abiotic stresses and many socio-economic factors. Imbalanced and inadequate use of nutrients is one of the major constraints for lower yield of groundnut. Proper fertilizer management of groundnut crop with right kind of nutrients at correct time adapting right method of application improve the production and soil fertility status. Integrated Nutrient Management (INM) is one among the possible way to improve the soil for sustainable farming. The INM practices increase the soil available nutrient, facilitates slow release of nutrients and thus reduce nutrient losses and enhance nutrient uptake of plants and results in higher productivity. Nitrogen (N) is the most important mineral nutrient which affects the growth and yield of crops. Nitrogen often limits the primary production in agricultural and natural ecosystems (De vries *et al.,* 2006) therefore, its availability in sufficient quantities in plant available form is crucial for higher crop yields. The combined use of organic manure and N fertilizer maintains a continuous N supply, prevents losses and thus helps in more efficient utilization of the applied nitrogen (Dwivedi *et al*., 2016).

Foliar feeding is a very effective and economical way to correct plant nutrient deficiencies and bridging the gap of crop nutrient requirement. Foliar application of nutrients has been proved to be an important asset in fertilizer application with a specific aim of increasing nutrient availability at the time of need particularly at the later stage of plant growth (Kuepper, 2003). Foliar application of salicylic acid and TNAU groundnut rich increases flowering, speed up photosynthesis, arrest flower drop and supplement the

required micronutrients at a faster rate. Hence, an effort has been made to increase the groundnut yield by combining foliar application of nutrients along with recommended dose of fertilizers.

Materials and Methods

The field experiment for this study was conducted at the farmer's field at Arasampalayam village in Rasipuram taluk of Namakkal district, Tamil Nadu during vaigasipattam (May – Sep), 2021. Geographically the field is situated at 11.44^{o} N latitude, 78.08^{o} E longitude with an altitude of +132.67 meters above mean sea level. The average annual rainfall of this study area is 640 mm. The entire cropping period received the rainfall of 118 mm distributed over 22 rainy days. The maximum temperature during cropping period ranged from 31^{o} to 37^{o}C, while the minimum temperature ranged from 23^{o} to 28^{o}C with a mean of 25.5^{o}C and the relative humidity ranged from 48 to 70 per cent.

The soil of the experimental field was sandy loam in texture with a pH of 8.4. The soil was low in available nitrogen (198.50), high in available phosphorus (24.75) and high in available potassium (348.20). The groundnut variety TNAU Co 6 was chosen for the study. The seeds were dibbled by using tractor drawn seed drill to maintain optimum plant population. The experiment was laid out in a Randomized Block Design (RBD) with three replications. The treatments consisted of T_0 – Absolute control (No organics and inorganics), T_1 – RDF through inorganic fertilizers (25:50:75 Kg N, P_2O_5, K_2O ha^{-1}), T_2 – 75% RDN + 25% N on equivalent basis of EFYM, T_3 – 50% RDN + 50% N on equivalent basis of EFYM, T_4 – 75% RDN + 25% N on equivalent basis of poultry manure compost, T_5 – 50% RDN + 50% N on equivalent basis of poultry manure compost, T_6 – T_2 + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS, T_7 – T_3 + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS, T_8 – T_4 + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS, T_9 – T_5 + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS.

The recommended dose of 25:50:75 kgs of NPK ha^{-1} in the form of urea (46% N), single super phosphate (16% P_2O_5) and muriate of potash (60% K_2O) were applied on machine sown groundnut crop. 50% N, 100% P_2O_5 and 50% K_2O were applied as basal dose. The remaining 50% N and 50% K_2O were top dressed in two equal splits on 20 DAS and 45 DAS. The recommended dose of P_2O_5 and K_2O was applied to all the treatments except absolute control. The treatments with different doses of N were applied as per treatment schedule. Besides, the enriched farm yard manure and poultry manure compost was applied well before the sowing of groundnut as per the treatments. Quantity of EFYM, poultry manure compost to be added to each treatment was calculated on the basis of N content in EFYM and poultry manure compost. The remaining recommended dose of N was supplied through inorganic fertilizers. Gypsum @ 80 kg S on 45 DAS, foliar application of salicylic acid @ 100 ppm and TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS were applied as per treatment schedule.

Irrigation was given immediately after sowing with due care to avoid excess soaking of seeds. The life irrigation was given on 3 DAS. The subsequent irrigation was given to the crop as and when required. The standard crop management practices were followed during the cropping period. The periodical observations on plant height, number of compound leaves plant^{-1}, leaf area index (LAI), dry matter production (DMP) and number of nodules plant^{-1} were recorded. The estimated data were analyzed as per the procedure outlined by Gomez and Gomez (1994). The critical difference was worked out at 5 per cent probability level for significant results.

Results and Discussion

Growth Attributes

The integrated use of organic manures and inorganic fertilizers significantly increased the growth attributes *viz.*, plant height, number of compound leaves plant^{-1}, leaf area index, number of nodules plant^{-1} and dry matter production. Among the various combinations, application of 75% RDN + 25% N on equivalent basis of poultry manure compost + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS (T_8) performed better than rest of the treatments.

In case of 30 DAS, application of RDF alone (T_1) resulted in higher growth parameter values. It might be due to RDF can be attributed to easy availability of nutrients required by plants leading to better growth. However, at 60 DAS and at harvest stages, the best result in growth attributes is obtained with application of 75% RDN + 25% N on equivalent basis of poultry manure compost + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS (T_8)might be due to slow and gradual release of N and other nutrients during all crop growth stages and sustains for longer period leads to more availability of nutrients than other treatments.

Plant height

Among the treatments, the integrated application of 75% RDN + 25% N on equivalent basis of poultry manure compost + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS (T_8) significantly registered the maximum mean plant height of 32.95 and 43.31 cm on 60 DAS and at harvest, respectively and it was followed by the application of 75% RDN + 25% N on equivalent basis of EFYM + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS (T_6). However, T_9- T_5 + Foliar application of salicylic acid @ 100 ppm + TNAU groundnutrich@5.0kgha^{-1}on 35 and 45 DAS and T_7-T_3 + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS were next in order and found to be on par with each other at both the stages of crop growth. The treatment T_0–Absolute control recorded the lowest mean plant height of 12.64, 20.56 and 28.57 cm on 30,60 DAS and at harvest,respectively.

The increase in plant height of groundnut was attributed to the gradual release of essential nutrients as required by the plant in a combined application of NPK and poultry manure compost along with foliar application of nutrients. Poultry manure contains essential nutrient elements associated with high photosynthetic activities and thus promotes root and vegetative growth. It also improves soil moisture retention, soil structure and aeration in addition to increased availability

of nitrogen. Nitrogen is known to enhance physiological activities in crops thereby improving the synthesis of photo assimilates. The results of increasing plant height in the integrated application of organic and inorganic fertilizer may be due to the steady release of essential nutrients as required by the groundnut crop. This could be due to supplying N, P and K nutrients in proper proportion through soil application and micronutrients through foliar application. These results are in conformity with the findings of Zalate and Padmani; Ayoola and Makinde (2009).

Number of leaves plant^{-1}

The integrated application of 75% RDN + 25% N on equivalent basis of poultry manure compost + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS (T_8) significantly registered the maximum mean number of leaves plant^{-1}of 41.85 and 36.50 on 60 DAS and at harvest, respectively and it was followed by the application of 75% RDN + 25% N on equivalent basis of EFYM+ Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS (T_6). However, T_9- T_5 + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS and T_7 - T_3 + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS were found to be next in order and on par with each other at both the stages of crop growth. The treatment T_0– Absolute control recorded the least number of leaves plant^{-1}of 19.87, 28.64 and 23.97 on 30, 60 DAS and at harvest, respectively.

It might be due to positive interaction of 75% RDN + poultry manure compost along with foliar application of nutrients.More number of leaves was recorded due to beneficial influence of organic manures which release growth promoting substances along with enhancement of nitrogen availability (Araei and Mojaddam, 2014).

Leaf area index (LAI)

Among the treatments, the integrated application of 75% RDN + 25% N on equivalent basis ofpoultry manure compost + Foliar application of salicylic acid @100 ppm + TNAU groundnut rich @ 5.0 kgha^{-1} on 35 and 45 DAS(T_8) significantly registered the maximum mean leaf area index of 3.94 and 3.65 respectively on 60 DAS and at harvest, respectively and it was followed by the application of 75% RDN + 25% N on equivalent basis of EFYM+ Foliar application of salicylic acid@100 ppm + TNAU groundnut rich @ 5.0kgha^{-1} on 35 and 45 DAS(T_6). However, T_9- T_5 + Foliar application of salicylic acid @100 ppm + TNAU groundnut rich @ 5.0kgha^{-1} on 35 and 45 DAS and T_7 -T_3 + Foliar application of salicylic acid @100 ppm + TNAU groundnut rich @ 5.0kgha^{-1} on 35 and 45 DAS were found to be next in order and on par with each other at both the stages of crop growth. The least leaf area index of1.38, 2.85 and 2.64 on 30, 60 DAS and at harvesting stages, respectively were recorded in the absolute control treatment (T_0).

The increase in leaf area could be attributed to increased cell division and increased cell expansion. Leaf area increased with increasing of nutrient quantity and advancement of crop growth period. The highest leaf area was obtained might be due to the effect of higher or optimum nutrient added, especially nitrogen and added extra nutrient through organic manures. Moreover, foliar application of salicylic acid and TNAU rich results in highest leaf area may be due to its important role on activating cell division and biosynthesis of organic foods. These findings are in agreement with findings of Biswas (2011) and Khan *et al.* (2003).

Number of nodules plant^{-1}

Among the treatments, the integrated application of 75% RDN + 25% N on equivalent basis ofpoultry manure compost + Foliar application of salicylic acid @100 ppm + TNAUgroundnut rich @ 5.0kg ha^{-1}on 35 and 45 DAS(T_8)significantly registered the maximum mean number of nodules plant^{-1} of 85.11, in which 48.15 are effective mean nodules plant^{-1}, respectively and it was followed by the application of 75% RDN + 25% N on equivalent basis of EFYM+ Foliar application of salicylic acid@100 ppm + TNAUgroundnut rich @ 5.0kg ha^{-1} on 35 and 45 DAS(T_6). However, T_9- T_5 + Foliar application of salicylic acid @100 ppm + TNAUgroundnut rich @ 5.0kg ha^{-1} on 35 and 45 DAS and T_7 -T_3 + Foliar application of salicylic acid @100 ppm + TNAU groundnut rich @ 5.0kg ha^{-1} on 35 and 45 DAS were found to be next in order on par with each other at all stagesof crop growth. The treatment T_0– Absolute control recorded the lowest mean value of 60.83 at harvest in which 31.85 are effective nodules respectively.

The increase in root nodules might have been due to the favourable effect of microbial population and interaction of poultry manure compost with soil biota improves soil health and fertility. The increase in the number of nodules per plant might be attributed to improved availability of nutrients due to release of nutrients from the applied compost and direct addition of P from the inorganic P. These findings are similar with the results of Ogutu (2013).

Dry matter production

The integrated application of 75% RDN + 25% N on equivalent basis ofpoultry manure compost + Foliar application of salicylic acid @100 ppm + TNAUgroundnut rich @ 5.0kg ha^{-1}on 35 and 45 DAS(T_8)significantly registered the maximum mean dry matter production of4954 and 7462 Kgha^{-1} on 60DAS and at harvest, respectively and it was followed by the application of 75% RDN + 25% N on equivalent basis of EFYM+ Foliar application of salicylic acid@100 ppm + TNAU groundnut rich @ 5.0kg ha^{-1} on 35 and 45 DAS(T_6). However, T_9 - T_5 + Foliar application of salicylic acid @100 ppm + TNAUgroundnut rich @ 5.0kg ha^{-1} on 35 and 45 DAS and T_7 -T_3 + Foliar application of salicylic acid @100 ppm + TNAU groundnut rich @ 5.0kg ha^{-1} on 35 and 45 DAS were found to be next in order on par with each other at both the stagesof crop growth. The treatment T_0– Absolute control recorded the lowest mean dry matter production of1532, 2658 and 3824 Kgha^{-1}on30, 60 DAS and at harvest, respectively.

Combining poultry manure compost with chemical fertilizer significantly influenced the dry matter yield. Enhanced dry matter accumulation might be due to the integrated effects of poultry manure compost and chemical fertilizer in improving the major and micronutrients availability, as well as improving soil physical, chemical and biological properties. The higher dry matter accumulation may be due to higher photosynthetic ability of crop as reflected through higher dry matter accumulation in leaf and

higher translocation of metabolites from leaf and stem to reproductive part during reproductive phase of crop growth. These findings are similar with the results of Dwivedi *et al*. (1990) and Karle *et al*. (2007).

Moreover, foliar application of salicylic acid results in highest leaf area and dry matter accumulation may be due to its important role on activating cell division and biosynthesis of organic foods and enhanced photosynthesis and higher photosynthetic rate as reflected through total dry matter. Foliar feeding of TNAU groundnut rich increase the growth characters was due to the fact that, improvement in photosynthesis and carbohydrate metabolism resulting into greater formation of photosynthates. These results are in agreement with the findings of Khan *et al*. (2003), Radhamani *et al*. (2002) and Shivakumar and Kumuthia (2003).

Conclusion

The integrated use of organic manures and inorganic fertilizers significantly increased the growth attributes of machine sown groundnut *viz.*, plant height, number of compound leaves plant^{-1}, leaf area index, dry matter production and number of nodules plant^{-1}. Among the various combinations, application of 75% RDN + 25% N on equivalent basis of poultry manure compost + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS (T_8) performed betterin obtaining higher growth attributes than rest of the treatments.

Table 1: Effect of integrated nutrient management (INM) on growth attributes of machine sown groundnut.

Treatments	Plant height (cm)			No. of compound leaves plant^{-1}			LAI		
	30 DAS	60 DAS	Harvest	30 DAS	60 DAS	Harvest	30 DAS	60 DAS	Harvest
T_0 – Absolute control (No organics and inorganics)	12.64	20.56	28.57	15.62	28.64	23.97	0.80	2.85	2.64
T_1 – RDF through inorganic fertilizers (25:50:75 Kg N, P_2O_5, K_2O ha^{-1})	15.38	27.47	35.93	19.87	35.26	30.51	1.38	3.39	3.2
T_2 – 75% RDN + 25% N on equivalent basis of EFYM	15.06	25.61	33.54	18.12	33.05	28.55	1.24	3.21	3.01
T_3 – 50% RDN + 50% N on equivalent basis of EFYM	14.86	23.65	31.24	17.24	30.89	26.45	1.14	3.02	2.82
T_4 – 75% RDN + 25% N on equivalent basis of poultry manure compost	15.14	25.81	33.78	18.54	33.12	28.62	1.32	3.25	3.04
T_5 – 50% RDN + 50% N on equivalent basis of poultry manure compost	14.94	23.89	31.28	17.84	30.95	26.60	1.17	3.05	2.86
T_6 – T_2 + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS	15.08	31.17	40.32	18.15	39.65	34.52	1.26	3.76	3.51
T_7 – T_3 + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS	14.88	29.20	38.04	17.24	37.35	32.48	1.13	3.54	3.34
T_8 – T_4 + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS	15.16	32.95	43.31	18.56	41.85	36.50	1.34	3.94	3.65
T_9 – T_5 + Foliar application of salicylic acid @ 100 ppm + TNAU groundnut rich @ 5.0 kg ha^{-1} on 35 and 45 DAS	14.96	29.34	38.10	17.85	37.47	32.56	1.18	3.59	3.36
SEm±	**0.04**	**0.52**	**0.68**	**0.04**	**0.58**	**0.54**	**0.009**	**0.03**	**0.04**
CD (p=0.05)	**0.14**	**1.58**	**2.06**	**0.16**	**1.74**	**1.61**	**0.02**	**0.10**	**0.13**

Table 2 : Effect of INM on number of nodules plant^{-1}and dry matter production (kg ha^{-1}) of machine sown groundnut.

Treatments	Number of nodules plant^{-1}		DMP (kg ha^{-1})		
	Total nodules plant^{-1}	No. of effective nodules plant^{-1}	30 DAS	60 DAS	Harvest
T_0 – Absolute control (No organics and inorganics)	60.83	31.85	958	2658	3824
T_1 – RDF through inorganic fertilizers (25:50:75 Kg N, P_2O_5, K_2O ha^{-1})	74.96	41.08	1532	3852	5791
T_2 – 75% RDN + 25% N on equivalent basis of EFYM	70.45	38.24	1315	3485	5084
T_3 – 50% RDN + 50% N on equivalent basisof EFYM	66.56	36.37	1076	3015	4431
T_4 –75% RDN + 25% N on equivalent basis ofpoultry manure compost	71.23	38.86	1428	3574	5271
T_5 – 50% RDN + 50% N on equivalent basis ofpoultry manure compost	67.85	36.75	1239	3118	4567
T_6 – T_2 + Foliar application of salicylic acid@100 ppm + TNAU groundnut rich @ 5.0kg ha^{-1} on 35 and 45 DAS	82.54	46.23	1354	4628	6956
T_7 – T_3 + Foliar application of salicylic acid @100 ppm + TNAU groundnut rich @ 5.0kgha^{-1} on 35 and 45 DAS	78.36	44.12	1098	4236	6313
T_8 – T_4 + Foliar application of salicylic acid @100 ppm + TNAU groundnut rich @ 5.0kgha^{-1} on 35 and 45 DAS	85.11	48.15	1464	4954	7462
T_9 – T_5 + Foliar application of salicylic acid @100 ppm + TNAU groundnut rich @ 5.0kgha^{-1} on 35 and 45 DAS	79.65	44.58	1276	4320	6452
SEm±	**0.81**	**0.49**	**18.74**	**64.68**	**115.03**
CD(p=0.05)	**2.40**	**1.47**	**56.12**	**193.65**	**345.09**

RDN* - Recommended dose of nitrogen RDF* - Recommended dose of fertilizers
EFYM* - Enriched farmyard manure DAS* - Days after sowing

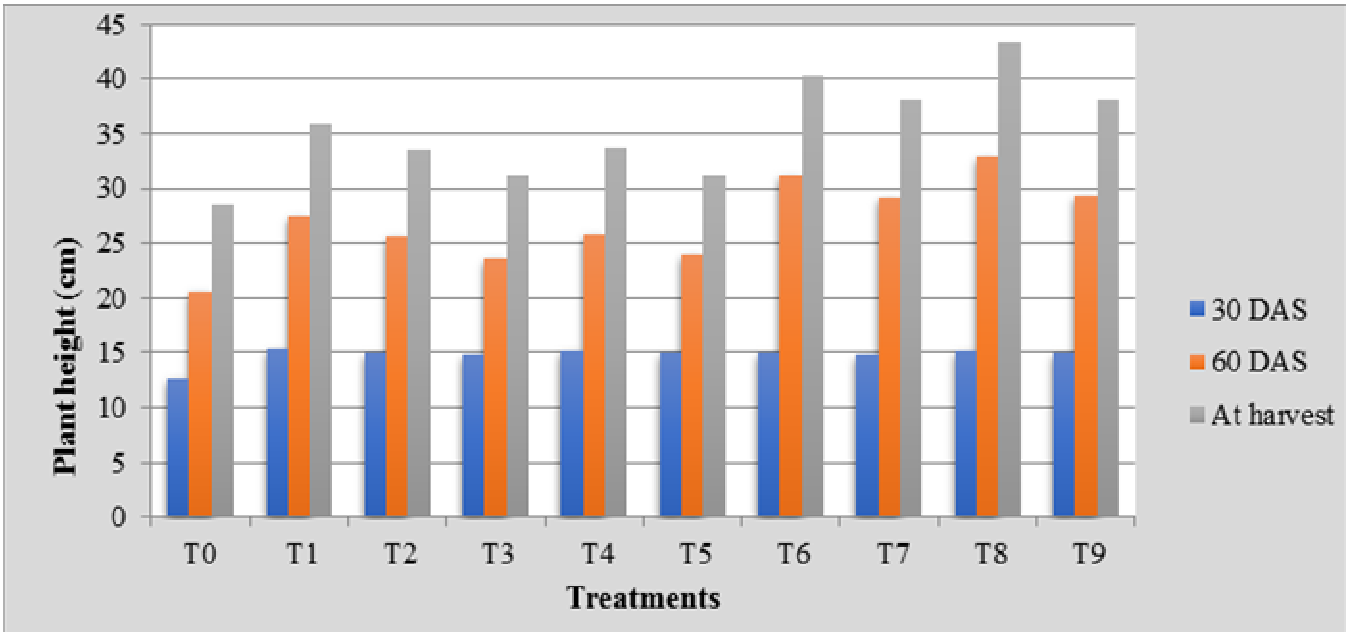

Fig 1: Effect of integrated nutrient management on plant height at different growth stages of machine sown groundnut

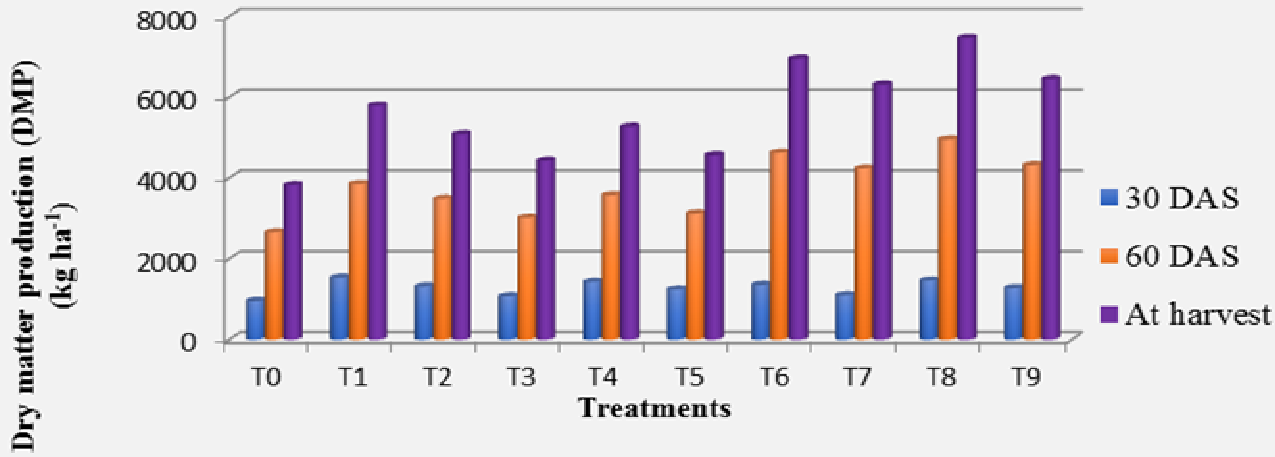

Fig 2: Effect of integrated nutrient management on dry matter production (DMP) (kg ha^{-1}) at different growth stages of machine sown groundnut

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