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Rahul Chandra
M. Sc. (Agriculture) Crop Physiology, Department of Crop Physiology, Agricultural College Bapatla, Andhra Pradesh, India

Dr. Sreekanth B
Scientist (Crop physiology) AICRP on Cotton, RARS Lam, Guntur, Andhra Pradesh, India

Dr. K Jayalalitha
Professor,
Department of Crop Physiology Agricultural College, Bapatla, Andhra Pradesh, India

Dr. T Srinivas
Principal Scientist,
AICRP on Rice, RARS Maruteru, Andhra Pradesh, India

Corresponding Author:
Rahul Chandra
M. Sc. (Agriculture) Crop Physiology, Department of Crop Physiology, Agricultural College Bapatla, Andhra Pradesh, India

Effect of supplemental application of nitrogen during reproductive stage on yield parameters in groundnut (*Arachis hypogaea* L.)

Rahul Chandra, Dr. Sreekanth B, Dr. K Jayalalitha and Dr. T Srinivas

Abstract
The present investigation was conducted to assess the effect of supplemental application of nitrogen during reproductive stage on yield parameters in groundnut in Agricultural College Farm, Bapatla, Andhra Pradesh. As treatment, 10 kg N ha^{-1} was applied during four different reproductive growth stages of groundnut *viz.*, at flowering (30 DAS, 50% plants have open flowers), at peg initiation (50 DAS, 50% plants have at least one elongated peg), at pod initiation (60 DAS, 50% plants have an elongated peg with ovary tip beginning to swell to at least twice peg diameter) and at mid pod development stage (72 DAS, a day at the middle of crop maturity and pod initiation) along with an untreated control with only recommended basal application of nitrogen. These treatments were imposed on groundnut *cv* TAG-24 in a randomized block design. The results revealed that nitrogen supplementation during reproductive stage contributed to increase in the number of pods produced by the plant as well as the supplementation of nitrogen at flowering stage was found to be most effective compared to other stages in case of pod yield. Maximum absorption and utilization of the supplemented nitrogen, which contributes to seed yield occurred when supplemented at flowering stage. The data on oil content indicated that there was no significant difference observed between treatments and the control.

Keywords: Groundnut, reproductive stages, nitrogen, supplementation, yield

Introduction
Groundnut (*Arachis hypogaea* L.) is considered as the 'king' of oilseeds. It is also known as peanut, earthnut, gobbers, pinders or manila nut (Beghin *et al.*, 2003) [2]. Groundnut is the world's thirteenth most important food crop, fourth most important source of edible oil and the third most important source of vegetable protein (Taru *et al.*, 2008) [8]. While being a valuable source of all the nutrients, it is a low-priced commodity. Groundnut haulms and leaves serve as a rich source of cattle feed and raw material for preparation of silage. Its seeds (kernels) contain 40-50% fat, 20-50% protein and 10-20% carbohydrates (FAO, 2006) [3].
Groundnut crop (*Arachis hypogaea* L.) is characterised by indeterminate growth habit in that its terminal meristem never becomes reproductive and there is no precise end to vegetative growth. In groundnut rapid vegetative growth starts only after flowering and it continues till maturity (Williams *et al.*, 1975) [9]. Nitrogen is the key plant nutrient that stimulates root and shoot growth. Jana *et al.* (1990) [5] reported that a pod yield of 1.48 t ha-1 was realised with 40 kg N ha-1 compared to 0.90 t ha-1 with no nitrogen. Under optimum edaphic and climatic conditions groundnut can fix 222 kg N ha-1 which was 50% of the N accumulated in plants. The response of groundnut to fertilizer application is not consistent and varies widely from field to field. It was being observed that farmers generally do not apply sufficient fertilizers to groundnut crop. This may be probably due to it being a leguminous crop fixes atmospheric nitrogen. However, experimental evidence clearly indicated that yield of groundnut can be improved considerably with application of NPK and gypsum (Singh *et al.*, 1997) [7].

Materials and Methods
The field experiment was conducted in Field No. 48 of Southern Block of Agricultural College Farm, Bapatla, Guntur district, Andhra Pradesh. It is 9 km away from the Bay of Bengal, located at an altitude of +5.49 m, and 150 54' N latitude and 800 25' E longitude. Groundnut cultivar TAG-24 was chosen for the experiment, since it is the commonly cultivated variety during *Rabi* season in the region with high yielding capacity. Randomized block design (RBD) was adapted with five treatments, each replicated four times.

Treatments were applied on all treatments except control (N0) where no N was supplemented during crop growth period. 10 kg N $ha^{-1}$was supplemented at all other stages mentioned. All the treatments include a basal application of N @ 30 kg ha^{-1}. The treatments were applied at reproductive growth period of groundnut which was divided into four different stages *viz*., flowering (30 DAS, 50% plants have open flowers), peg initiation (50 DAS, 50% plants have at least one elongated peg), pod initiation (60 DAS, 50% plants have an elongated peg with ovary tip beginning to swell to at least twice peg diameter) and mid pod development stage (72 DAS, a day at the middle of crop maturity and pod initiation. Details of the treatment are given in Table 1.

Results and Discussions

The effect of supplemental application of nitrogen during reproductive stage on yield parameters in groundnut is presented in Table 2. In the case of number of pods $plant^{-1}$, all the treatments were found to be significantly higher than the control. The maximum number of pods $plant^{-1}$ was observed in Np (12.65) followed by Npo-2 (11.31). The treatment Np was found to be significantly higher than the control (8.18) and treatment Npo-2 (10.8). Hence the results suggested that nitrogen supplementation during reproductive stage contributed to increase in the number of pods produced by the plant. This may be due to the fact that a single basal application of nitrogen would be lost by leaching in the friable sandy soil so supplementing it at a later stage contributed to more efficient uptake by the crop. The supplementation of nitrogen at flowering stage gave maximum number of pods $plant^{-1}$. But when N was supplemented during late pod filling stage, least increment was observed in number of pods $plant^{-1}$, this may be due to the utilisation of supplemented nitrogen for pod development rather than new pod formation. These findings were in conformity with Ravisankar *et al.* (2010) [6].

Regarding pod yield, all the treatments were found to be significantly superior over the control, but there was no significant difference observed between the treatments. The maximum pod yield was observed in the treatment Np (8.32 g $plant^{-1}$) followed by Nf (8.30 g $plant^{-1}$). The supplementation of nitrogen at flowering stage was found to be most effective compared to other stages. When N was supplemented at mid pod development stage, least effect was observed when compared to other treatments. The pronounced superiority of treatments above control may be due to fact that a single basal dose of nitrogen given may be subjected to considerable leaching and will not be available for plant, in such a case supplementation increases the amount of nitrogen efficiently absorbed by the plant. The findings here were in accordance with work done on groundnut by Almaliki *et al.* (2019) [1].

The data on seed / kernel yield of groundnut revealed that the highest kernel yield was noted in the treatment Np (8.19 g $plant^{-1}$) followed by Nf (7.09 g $plant^{-1}$). The least kernel yield was noted in N0 (control, 5.62 g $plant^{-1}$). Significantly higher seed yield was noticed in the treatment Np in comparison to all other treatments and control. The treatments Nf (7.09 g $plant^{-1}$) and Npo-1 (6.75 g $plant^{-1}$) were found to be significantly higher than control. Based on the above results it can be concluded that, maximum absorption and utilization of the supplemented nitrogen, which contributes to seed yield occurred when supplemented at flowering stage and lower yield is obtained when applied at a more progressed stage in reproductive growth of groundnut. These observations were in accordance with the findings made by Inforzato *et al.* (1973) [4].

From the results obtained from the data on oil content, it can be concluded that there was no significant difference observed between treatments and the control. The maximum oil content noted was in treatment Npo-1 (46.01%) which was almost on par with other treatments and control. Nitrogen applied as a single basal dose or when supplemented at later stage had no effect on oil content. The observed results were in accordance with the findings of Zade *et al.* (1985) [10].

Table 1: Details of the treatments

S. No.	Designation	Description
1.	N0	Control without supplemental N application
2.	Nf	N supplementation at flowering stage
3.	Np	N supplementation at peg initiation stage
4.	Npo-1	N supplementation n at pod initiation stage
5.	Npo-2	N supplementation at mid pod development stage

Table 2: Effect of supplemental application of nitrogen during reproductive stage on yield parameters of groundnut *cv* TAG-24 during *rabi*, 2020.

	Treatment	Number of pods/plant	Pod yield/plant (g)	Kernel yield/plant (g)	Oil content (%)
1.	N0	8.18	6.32	5.62	45.20
2.	Nf	11.30	8.30	7.09	45.81
3.	Np	12.64	8.31	8.18	44.86
4.	Npo-1	11.12	8.23	6.75	46.00
5.	Npo-2	10.68	7.75	6.26	45.75
	SEm	0.52	0.31	0.31	0.56
	CD (0.05)	1.61	0.96	0.98	N.S
	CV (%)	9.66	8.03	9.41	2.46

Conclusions

From the present investigation, it can be concluded that nitrogen supplementation during reproductive stage contributed to increase in the number of pods produced by the plant. The supplementation of nitrogen at flowering stage was found to be most effective compared to other stages in case of pod yield. It was reported that maximum absorption and utilization of the supplemented nitrogen, which contributes to seed yield occurred when supplemented at flowering stage and lower yield is obtained when applied at a more progressed stage in reproductive growth of groundnut. The data on oil content indicated that there was no significant difference observed between treatments and the control.

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