Nitrogen Uptake and Quality Parameters in Groundnut [*Arachis hypogaea* (L.)] Influenced by Different Weed Management Practices Under Arid Zone of Rajasthan, India

ABSTRACT

The field experiment was conducted at Agricultural Research station, Mandor, Agriculture University, Jodhpur during kharif, 2019 to evaluate nitrogen uptake and quality parameters as influenced by different weed management practices in *kharif* groundnut. The experiment was laid out in randomized block design (RBD) with thirteen treatments of replicated thrice. Results revealed that weed-free treatment found significantly higher total nitrogen uptake by crop, protein content in kernel, oil out-turn and lowest amount of nitrogen removal by weeds compared to weedy check. Among the herbicidal treatments, application of pendimethalin + imazethapyr at 1.0 kg/ha + one manual weeding at 30 DAS recorded significantly higher total nitrogen uptake by crop (240.8 kg/ha), protein content in kernel (25.8%), oil out-turn (1214.7 kg/ha) and lowest amount of nitrogen removal by weeds (0.4 kg/ha) which was closely followed by pendimethalin at 1.0 kg/ha (PE) + imazethapyr at 75 g/ha 20 DAS, pendimethalin at 1.0 kg/ha (PE) + one manual weeding at 30 DAS and pendimethalin + imazethapyr at 1.0 kg/ha (PE) + quizalofop-p-ethyl at 50 g/ha at 20 DAS.

Key words: *Groundnut, Herbicides, Uptake, Quality parameters, Weed management.*

1. INTRODUCTION

Groundnut (*Arachis hypogaea* L.), commonly known as peanut, is an important leguminous crop cultivated worldwide for its economic and nutritional significance. In India, groundnut is being produced to the extent of 10.11 million tonnes from 5.57 million ha area, with average productivity of 1759 kg /ha in 2021-22 (DES, 2022). Rajasthan contributed 1.70 million tonnes from 0.79 million ha area, with an average yield of 2132 kg /ha in 2021-22 (DES, 2022). However, weed infestation poses a considerable challenge, causing yield losses ranging from 74 to 92% (Jat *et al.,* 2011). Mulik *et al.* (2010) reported that the initial 3-4 weeks of crop growth period are critical for weed control in kharif groundnut. The initial growth of groundnut, which typically takes around six weeks, allows weeds to grow exponentially, leading to intense competition with the crop and a significant reduction in groundnut yield (Shanwad *et al.,* 2011). Weeds not only compete with the crop for essential resources such as underground space, water, nutrients, and light but also hinder pegging, pod development, and make harvesting of groundnut a

cumbersome task (Regar, 2017). Allowing weeds to persist until harvest can deplete 162.8 kg of nitrogen, 21.7 kg of P_2O_5, and 141.8 kg of K_2O per hectare (Singh *et al.,* 2017). However, the use of herbicides and manual weeding has been shown to significantly reduce nutrient removal by weeds and enhance nutrient uptake by groundnut crops (Yadav *et al.,* 1983). In weed management, hand weeding is known to be effective, but it is also labor-intensive and costly (Rao and Chauhan, 2015). On the other hand, chemical control methods are quicker, more efficient, and save time and labor (Kumar, 2009). Selective herbicides are capable of controlling specific weed species, but they may not be suitable for managing a complex weed flora. Pre-emergence herbicide application (PE) can effectively control weeds for a limited period, but late-emerging weeds might escape its impact, requiring the use of post-emergence herbicide application (PoE). To overcome the limitations of individual weed management methods, integrating herbicides with other approaches has shown promise (Yaduraju *et al.,* 2015). In the market, several pre-mix herbicides are now available, offering effective control over the complex weed flora associated with groundnut. The study investigates the use of herbicides and cultural practices to combat this issue and enhance groundnut productivity in the arid zone of Rajasthan.

2. MATERIAL AND METHODS

The field experiment was conducted during kharif season of 2019 at Agricultural Research Station, Mandor, Agriculture University, Jodhpur. The soil of experimental site was loamy sand in texture, slightly alkaline in nature (pH 8.2), low in organic carbon (0.13 %) and available nitrogen (174 kg N/ha), whereas, medium in phosphorus (22.0 kg P_2O_5/ha) and available potassium (325 kg K_2O/ha). The bulk density of the experimental field soil is 1.77 mg/m^3 and EC (0.13 dS/m). The mean daily maximum and minimum temperatures fluctuated between 34.0 to 40.8 °C and 14.9 to 29.9 °C, respectively during the crop growing season. The cumulative rainfall during experimentation approximately 190 mm was received with 10 rainy days in growing season (25th MW of June to 44th MW of November, 2019). The average daily relative humidity fluctuated between 20.4 to 92.9 % during the experimental season. The experiment comprising of thirteen treatments viz., W_1- Pendimethalin 30 EC @ 1.0 kg/ha (PE), W_2- Pendimethalin 38.7 CS @1.0 kg/ha (PE), W_3- Pendimethalin 30 EC + imazethapyr 2 EC @ 1.0 kg/ha (PE) (ready-mix), W_4- Imazethapyr 10 SL @75 g/ha 20 DAS (PoE), W_5- Imazethapyr + imazamox (pre-mix) @ 70 g/ha 20 DAS, W_6- Pendimethalin 30 EC @ 1.0 kg/ha (PE) + imazethapyr @ 75 g/ha 20 DAS, W_7- Pendimethalin

30 EC @1.0 kg/ha (PE) + quizalofop-p-ethyl @ 50 g/ha 20 DAS W_8- Sodium aciflourfen 16.5 % + clodinafop propargyl 8 % (ready-mix) @ 200 g/ha 20 DAS, W_9- Pendimethalin 30 EC+ imazethapyr 2 EC @ 1.0 kg/ha (PE) (ready-mix) + quizalofop- p-ethyl @ 50 g/ha 20 DAS, W_{10}- Pendimethalin 30 EC @ 1.0 kg/ha (PE) + manual weeding at 30 DAS, W_{11}- Pendimethalin 30 EC + imazethapyr 2 EC @ 1.0 kg/ha (PE) (ready-mix) + manual weeding at 30 DAS, W_{12}- Weed free and W_{13}- Weedy check was laid out in randomized block design (RBD) with three replications. The plot size of each treatment was 18 m^2 (5 x 3.6 m^2). The groundnut crop variety 'HNG-69' was sown on 29 June in 2019 at 30 cm row-to-row and 10 cm plant-to-plant spacing using 100 kg kernel/ha. All the recommended improved practices were followed in this experiment including fertilizers and plant protection measures. All the herbicides were applied as per treatment by using knapsack sprayer with flat fan nozzle using 600 litres of water per hectare. The oil content in groundnut kernel was extracted by Nuclear Magnetic Resonance (NMR) technique suggested by Tiwari *et al*., 1974. The nitrogen content in plant was estimated by the Modified Kjeldahl's method given by Jackson, 1973. Uptake of nitrogen at harvest in kernel and haulm in crop, nitrogen removal by weeds and oil out-turn was calculated in kg/ha by using the standard formula. Protein content in kernel was calculated from the per cent nitrogen in the kernel multiplied by the conversion factor 5.46 and expressed as per cent protein content. Since, globulins contains 18.3 % N, the conversion factor of 5.46 for protein of groundnut was used (Reddy, 1988). Experimental data recorded in various observations were statistically analyzed in accordance with the "analysis of variance" technique as described by Panse and Sukhatme (1978). The critical difference (CD) for the treatment comparisons were worked out wherever the variance ratio (F test) was found significant at 5 % level of probability. To clarify the nature and magnitude of treatments effects, summary tables along with standard errors of means (SEm ±) and CD (P = 0.05) were prepared.

3. RESULTS AND DISCUSSION

3.1 Nitrogen content and uptake by crop

Data (Table 1) show that nitrogen content in kernel and haulm was improved significantly due to various weed management treatments compared to weedy check (3.7 % and 1.4 %, respectively). However, numerically the higher amount of nitrogen content was estimated under weed free plot (4.8 % and 1.7 %, respectively) which was found statistically at par with all herbicidal treatments. All the weed

management treatments caused to improve the nitrogen uptake by crop (kernel, haulm and total) significantly compared to weedy check (Table 1). The highest N uptake was recorded with weed free plot and lowest in weedy check. Among the herbicides, pendimethalin + imazethapyr at 1.0 kg/ha (PE) + one manual weeding at 30 DAS followed by pendimethalin at 1.0 kg/ha (PE) + imazethapyr at 75 g/ha 20 DAS significantly increased N uptake by kernel, haulm and total compared to rest o the herbicidal treatments and it was at par on weed free check. This might be due to decreased crop weed competition and concurrently increased in nitrogen availability, better crop growth and higher crop dry matter production coupled with more nitrogen content. The similar results were also reported by Sharma *et al.* (2015).

3. 2 Nitrogen content and removal by weeds

It is evident from the data (Table 2) that significantly lower nitrogen content and removal by weeds was recorded due to various weed management treatments over weedy check (2.8 % and 17.2 kg/ha, respectively). Application of pendimethalin + imazethapyr at 1.0 kg/ha (PE) + one manual weeding at 30 DAS recorded significantly lower nitrogen content and removal by weed (0.4 % and 0.4 kg/ha, respectively) which was closely followed by pendimethalin at 1.0 kg/ha (PE) + imazethapyr at 75 g/ha at 20 DAS, pendimethalin at 1.0 kg/ha (PE) + one manual weeding at 30 DAS and pendimethalin + imazethapyr at 1.0 kg/ha (PE) + quizalofop-p-ethyl at 50 g/ha at 20 DAS (0.7, 0.7 and 0.9 %, respectively) compared to rest of the herbicidal treatments. These treatments effectively controlled the weeds in field thereby reduced the removal of nitrogen. The nitrogen removal by weeds is a direct function of its dry matter and nitrogen content in weed. This is ascribed due to uncontrolled weed growth throughout the crop season resulted in a loss of 16.6 kg N/ha in weedy check plot. The nitrogen depletion by weeds in the present study also substantiates this fact. The results also corroborated with the finding of Reddy *et al.* (2016).

3.3 Protein content, oil content and Oil out-turn in groundnut

Data (Table 2) show that protein content in kernel was increased significantly due to weed management treatments compared to weedy check (20.0 %). However, numerically the higher protein content was computed under weed free plot (26.4 %). However, there was no significant variation in

protein content amongst different herbicidal treatments. Oil content in groundnut kernel was not influenced due to various weed management treatments as reported by Adhikary *et al.,* 2016. However, all weed management treatments significantly enhanced oil out-turn of groundnut over weedy check (Table 2). The highest oil production was obtained under weed free treatment (1314.2 kg/ha). Application of pendimethalin + imazethapyr at 1.0 kg/ha (PE) + one manual weeding (1214.7 kg/ha), pendimethalin at 1.0 kg/ha (PE) + imazethapyr at 75 g/ha 20 DAS (1186.1 kg/ha), pendimethalin + imazethapyr at 1.0 kg/ha (PE) + quizalofop-p-ethyl at 50 g/ha 20 DAS (117.4 kg/ha) and pendimethalin at 1.0 kg/ha (PE) + one manual weeding at 30 DAS (1112.8 kg/ha) recorded significantly higher oil yield over other herbicidal treatments, being on par to each other. The herbicidal treatments *viz.* pendimethalin + imazethapyr (ready-mix) at 1.0 kg/ha (PE), imazethapyr + imazamox (ready-mix) at 70 g/ha 20 DAS, pendimethalin at 1.0 kg/ha (PE) + quizalofop-p-ethyl at 50 g/ha 20 DAS, imazethapyr at 75 g/ha 20 DAS, pendimethalin at 1.0 kg/ha (both EC and CS formulation) and sodium aciflourfen + clodinafop propargyl (ready-mix) at 200 g/ha 20 DAS caused to produce higher oil yield over weedy check (404.7 kg/ha), the magnitude being 141.1, 134.5,118.0, 109.1, 100.3, 91.07 and 81.5 per cent, respectively. As protein content in kernel is a function of as N content, therefore, increased content of N in kernel under superior treatments seems to be the only reason attaining the higher protein content in groundnut kernel. However, improvement in oil content could be ascribed to the healthy kernel producing under comparatively weed free condition and also seems to be directly associated with higher seed index under superior treatments that produced healthy kernels. Zid (2006) also reported that maximum oil and protein content in kernel of groundnut was recorded with application of pendimethalin at 0.8 kg/ha (PE) + imazethapyr at 0.8 kg/ha (PoE) + hand weeding and interculturing at 30 DAS.

4. CONCLUSION

Based on the findings of this study, the application of pendimethalin + imazethapyr at 1.0 kg/ha + one manual weeding at 30 DAS, is the most effective treatment. This approach not only enhances nitrogen uptake by the crop but also improves protein content in kernels and increases oil out-turn. Additionally, it suppresses weed growth, reducing nitrogen removal by weeds and optimizing nutrient availability for the groundnut plants.

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Table 1: Nitrogen content and uptake by crop in groundnut as influences by various weed management treatments

Treatments	N content in kernel (%)	N content in haulm (%)	N uptake by kernel (kg/ha)	N uptake by haulm (kg/ha)	Total N uptake by crop (kg/ha)
Pendimethalin 30 EC at 1.0 kg/ha (PE)	4.5	1.6	77.5	87.4	164.9
Pendimethalin 38.7 CS at 1.0 kg/ha (PE)	4.5	1.5	74.2	84.9	159.1
Pendimethalin 30 EC + imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix)	4.6	1.6	93.0	97.5	190.5
Imazethapyr 10 SL at 75 g/ha 20 DAS (PoE)	4.5	1.6	81.1	88.1	169.1
Imazethapyr + imazamox (pre-mix) at 70 g/ha 20 DAS	4.5	1.6	90.3	95.1	185.3
Pendimethalin 30 EC at 1.0 kg/ha (PE) + imazethapyr at 75 g/ha 20 DAS	4.6	1.7	114.3	115.4	229.7
Pendimethalin 30 EC at 1.0 kg/ha (PE) + quizalofop-p-ethyl at 50 g/ha 20 DAS	4.6	1.6	85.6	94.1	179.6
Sodium aciflourfen 16.5 % + clodinafop propargyl 8 % (ready-mix) at 200 g/ha 20 DAS	4.5	1.5	71.3	80.1	151.4
Pendimethalin 30 EC+ imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix) + quizalofop- p-ethyl at 50 g/ha 20 DAS	4.6	1.6	107.6	111.0	218.6
Pendimethalin 30 EC at 1.0 kg/ha (PE) + manual weeding at 30 DAS	4.7	1.7	108.1	112.8	220.9
Pendimethalin 30 EC + imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix) + manual weeding at 30 DAS	4.7	1.7	120.7	120.1	240.8
Weed free	4.8	1.7	129.9	125.9	255.8
Weedy check	3.7	1.4	33.4	51.4	84.9
SEm±	0.15	0.06	6.62	6.36	10.37
CD (P=0.05)	0.43	0.17	19.32	18.57	30.26

Table 2: Nitrogen content in weed, N removal by weeds, Protein content, oil content and Oil out-turn in kernel of groundnut as influences by various weed management treatments

Treatments	Nitrogen content in weed (%)	Nitrogen removal by weeds at 50 DAS (kg/ha)	Protein content (%)	Oil content (%)	Oil out-turn (kg/ha)
Pendimethalin 30 EC at 1.0 kg/ha (PE)	2.0	5.0	24.8	47.0	811.0
Pendimethalin 38.7 CS at 1.0 kg/ha (PE)	2.1	5.7	24.5	46.8	773.3
Pendimethalin 30 EC + imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix)	1.3	2.7	25.0	48.1	976.0
Imazethapyr 10 SL at 75 g/ha 20 DAS (PoE)	1.9	4.4	24.6	47.1	846.4
Imazethapyr + imazamox (pre-mix) at 70 g/ha 20 DAS	1.5	3.2	24.7	47.4	949.4
Pendimethalin 30 EC at 1.0 kg/ha (PE) + imazethapyr at 75 g/ha 20 DAS	0.7	0.9	25.3	48.0	1186.1
Pendimethalin 30 EC at 1.0 kg/ha (PE) + quizalofop-p-ethyl at 50 g/ha 20 DAS	1.7	3.4	24.9	47.1	882.4
Sodium aciflourfen 16.5 % + clodinafop propargyl 8 % (ready-mix) at 200 g/ha 20 DAS	2.2	6.1	24.4	46.1	734.7
Pendimethalin 30 EC+ imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix) + quizalofop- p-ethyl at 50 g/ha 20 DAS	0.9	1.5	25.1	47.8	1117.4
Pendimethalin 30 EC at 1.0 kg/ha (PE) + manual weeding at 30 DAS	0.7	0.9	25.5	48.0	1112.8
Pendimethalin 30 EC + imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix) + manual weeding at 30 DAS	0.4	0.4	25.8	48.2	1214.7
Weed free	0.0	0.0	26.4	48.9	1314.2
Weedy check	2.8	16.6	20.0	44.6	404.7
SEm±	0.05	0.56	0.80	1.20	52.82
CD (P=0.05)	0.14	1.63	2.34	NS	154.16