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Effect of nitrogen on yield and yield attributes of soybean in Kunar, Afghanistan

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ABSTRACT

A field experiment was conducted at Research farm of Agriculture Faculty of Sayed Jamaluddin Afghani University in Kunar during 2020 to evaluate the effect of nitrogen rates and time of applications on yield and yield attributes of soybean. The experiment was laid out in Randomized complete block design (RCBD) and replicated thrice consisted of seven treatments Viz; T_1: Control, T_2: 12.5 kg N ha^{-1} as basal, T_3:25 kg N ha^{-1} as basal, T_4: 50 kg N ha^{-1} as basal, T_5: 6.25 kg N ha^{-1} as basal + 6.26 kg N ha^{-1} at flowering Stage, T_6:12.5 kg N ha^{-1} at basal + 12.5 kg N ha^{-1} at flowering stage and T_7: 25 kg N ha^{-1} at basal + 25 kg N ha^{-1} at flowering stage. The highest reproductive attributes like pod length, pods per plant, seeds per pod, seed index, grain and straw yield were found in T_7 which was statistically similar to T_6 and the lowest values of all the parameters were obtained from control treatment. The overall finding of this study indicated that 25 kg N ha^{-1} at basal + 25 kg N ha^{-1} at flowering stage can be applied to achieve better yield attributes and yield of soybean.

Key words: Nitrogen, soybean, rates and time of applications, yield and yield attributes

INTRODUCTION

Soybean [*Glycine max* (L.) Merr.] is one of the most important oilseed and grain legume corp rich in protein and is cultivated in many parts of the world. In the international trade markets, soybean is ranked number one in the world among the major oil crops. Worldwide the cultivation area for soybean is 122.30 million hectare with average productivity of 2.70 tonnes ha^{-1} and total production of 330.41 million metric tonnes production (FAO, 2019). In Afghanistan, it is also one of the most important crops for human being. It is used as soy naan, soy dishes, including soybean Korma (soup), soymilk and full-fat soy flour and soybeans for pregnant and lactating women. The production of soybean was record 4,000 metric tonnes with average productivity of 0.6 to 1.2 tonnes ha^{-1} (NEI, 2015; NEI, 2011). Yield of soybean is very low in Afghanistan due to number of reasons, viz. lack of high yielding varieties, fertilizer management and delayed sowing (Gathiye et al., 2020). Without N fertilization formers cannot achieve high yield. Nitrogen is essential nutrients as they are involved in many biochemical processes and their deficiency not only affects crop productivity but also the quality of produce for human and

animal consumption (Salvagiotti et al. 2009; Hari Krishnan and Jez, 2018). Nitrogen fertilizer has had positive effects on soybean growth and yield (Brevedan et al., 1987; Touchton and Ricker, 1986). Soybean yield can be increased by adding nitrogen fertilizers in critical growth stages of soybean. Split application of nitrogen supplies nitrogen according to the demand of a growing crop and can improve nitrogen use efficiency. Splitting N applications may decrease the loss of N applied at planting due to denitrification. Split application reduces the risk of losses as leaching. Split application of nitrogen can increase grain yield and grain protein content (Laharia et al., 2013). In Afghanistan, as per the NEI recommendation 50 kg urea ha^{-1} was applied in soybean at sowing and at flower initiation stage. Therefore, the study was conducted to find out the suitable combination of nitrogen rate and time of application to obtain better yield attributes and yield of soybean.

MATERIALS AND METHODS

A field experiment was conducted at Research Farm of Agriculture Faculty, Sayed Jamaluddin Afghani University (SJAU), Kunar, Afghanistan (34º 83' N latitude; 71º 12' E longitude) from June to Oct, 2020. Soybean high yielding variety (Hwang keum) was sown in the experiment. The experiment was laid out in Randomized Block Design with three replications. There were seven treatments Viz; T_1: Control, T_2: 12.5 kg N ha^{-1} as basal, T_3:25 kg N ha^{-1} as basal, T_4: 50 kg N ha^{-1} as basal, T_5: 6.25 kg N ha^{-1} as basal + 6.26 kg N ha^{-1} at flowering Stage, T_6:12.5 kg N ha^{-1} at basal + 12.5 kg N ha^{-1} at flowering stage and T_7: 25 kg N ha^{-1} at basal + 25 kg N ha^{-1} at flowering stage. The size of the individual plot was 3.5 m x 5m and total numbers of plots were 21. The different doses of nitrogen were applied as per treatment through urea. The dose and time of applications were kept as per the treatments. All the recommended cultural practices and inputs including fertilizers were applied uniformly to all the plots. Finally, plants were harvested and data on yield and yield attributes parameters were collected from crop samples. Grain yield and straw yield altogether were considered as biological yield. Harvest index denotes the ratio of grain yield to biological yield multiplied by 100. Analysis of variance was done with the help of computer package program according to Gomez and Gomez (1984) and the mean differences among different treatments were adjudged by C.D test.

RESULTS AND DISCUSSION

Effects of treatment on reproductive attributes

Significant variation was measured in case of pod length of soybean due to application of different nitrogen rates and application times (Table 1).

Table 1. Yield and yield attributes of soybean as influenced by different nitrogen rates and time of applications

Treatment	Pod length (cm)	Pods per plant (no.)	Seeds per pod (no.)	Seed index (g)	Seed yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
T_1	4.09	88.00	2.00	12.00	1.38	4.31	32.01
T_2	4.62	115.67	2.22	12.00	1.53	4.83	31.75
T_3	4.77	158.11	2.44	12.55	162	4.88	33.16
T_4	4.61	168.78	2.78	12.78	1.68	5.42	30.95
T_5	4.68	136.67	2.33	12.63	1.85	6.09	30.43
T_6	4.84	200.22	2.78	13.30	2.04	6.33	32.25
T_7	5.16	247.22	2.89	13.26	2.15	6.94	30.99
C.D. 5 %	0.64	88.00	0.40	NS	0.15	0.38	NS

The longest pod was observed in T_7 which was statistically similar with the rest of the treatments except T_1. However, the shortest pod was recorded from T_1. Nutrient elements ensure maximum accumulation of photo-synthates to the pod, thus increase the length of pod. These findings are in accordance with the results of Khaim et al. (2013).

Analysis of variance showed that number of pods per plant of soybean showed statistically significant variation for the application of different nitrogen application rates and time of applications (Table 1). The highest number of pods was recorded in T_7 which was found statistically similar with T_6, while the minimum number of pods per plant from T_1. This finding was supported by Begum et al. (2015) who observed that increasing nitrogen rate increased the number of pods per plant.

Number of seeds was exposed significantly with different nitrogen rates and application times (Table 1). The maximum number of seeds pod^{-1} was recorded from T_7 treatment, which was statistically similar to T_6 and T_4 treatments, whereas the minimum was recorded from T_1, which was at par with T_2, T_3 and T_5. This finding is consistence with the finding of Patil and Udmale (2016).

Seed index (g)

Seed index of soybean did not varied significantly with different rates and time of nitrogen application (Table 1). The maximum seed index of soybean was weighted from T_6 treatment whereas the minimum was recorded from T_1.

Grain yield

Yield of soybean varied significantly with different rates and time of nitrogen applications (Fig. 1). The highest yield of soybean was obtained from T_7, which was statistically similar with T_6 whereas the lowest was obtained from T_1. The results showed that application of nitrogen at later growth stages resulted in higher grain yield as compare to nitrogen application at sowing alone. This might be due to proper applying of nitrogen in later stages which help in increasing crop yield. Caliskan, 2008 reported that 40 kg N ha^{-1} application of starter and top dressed nitrogen can be beneficial to improved yield of soybean. Khalili et al., 2016 also reported that application of N rates and time of applications increased grain and stover yield of maize over control

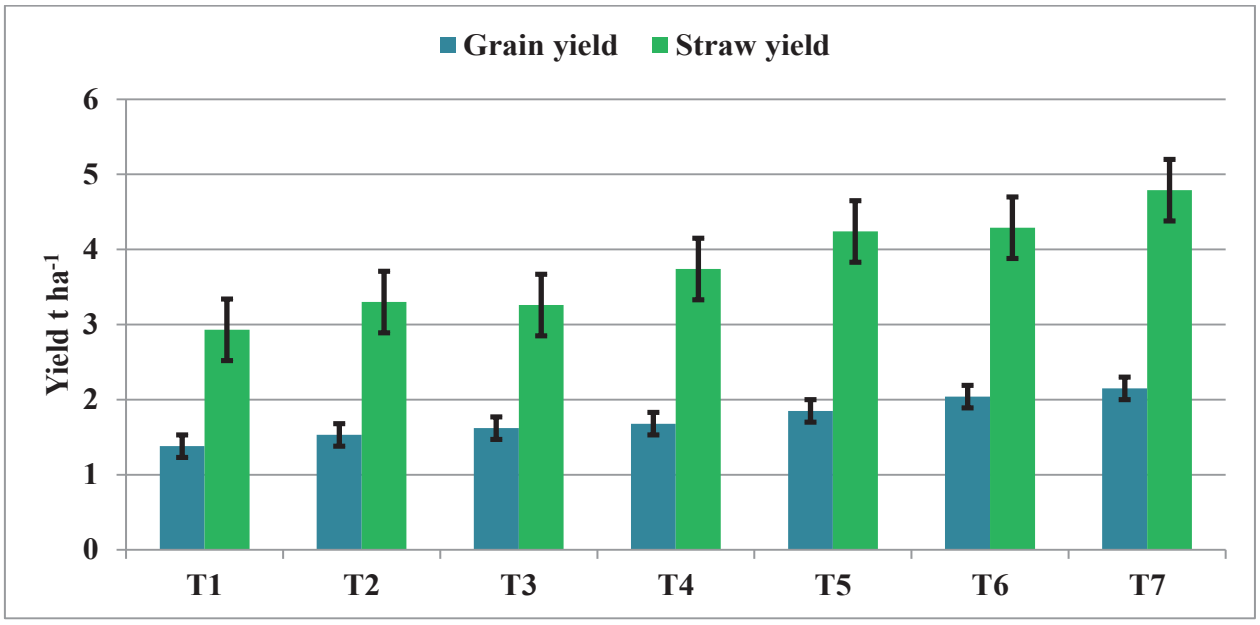

Fig. 1. Grain and stover yield of soybean as influenced by different nitrogen rates and time of applications

Straw yield

This research work exhibited distinct variation in straw yield of soybean with different rates and time of nitrogen application (Fig. 1). The maximum straw yield of soybean was produced from T_7 followed by T_6 and T_5. However, the minimum was produced from T_1. Khaim et al. (2013) observed that application of organic and inorganic fertilizers increased the stover yield of soybean.

Biological yield

It is evident from (Table 1) that biological yield was significantly different with rates and time of nitrogen application. The highest biological yield was found in T_7 followed by T_6 and T_5, while the lowest was found in T_1.

Harvest index (%)

Harvest index of soybean was not varied significantly due to various treatments of nitrogen rates and time of applications (Table 1). However, numerically the highest harvest index was obtained from T_3 and the lowest harvest index of soybean was recorded from T_5. The results are in contrary with the results of Khaim et al. (2013) who reported that harvest index was influenced by the application of organic and inorganic fertilizer.

CONCLUSION

Nitrogen rates and time of applications significantly affected soybean yield attributes and yield. Superior yield attributes and yield of soybean can be obtained with the application 25 kg N ha^{-1} at basal + 25 kg N ha^{-1} at flowering stage.

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