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Effect of Imazethapyr on Symbiotic Activities, Quality and Nutrient Uptake of Blackgram (*Vigna mungo* L.)

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ABSTRACT: A field experiment completed during the *summer* season of 2022. The field study was conducted in the Agronomy farm at school of agricultural sciences and rural development, Nagaland University. The experiment was laid out in Randomize Block Design (RBD) with three replications and 7 weed control Treatments with Imazethapyr *viz*; T_1 (Weedy check), T_2 (Two hand weeding at 20 DAS and 40 DAS, T_3 (Imazethapyr @ 50 g *a.i.* ha^{-1} at 10 DAS), T_4 (Imazethapyr @ 75 *g a.i.* ha^{-1} at 10 DAS), T_5 (Imazethapyr @ 50 g *a.i.* ha^{-1} at 15 DAS), T_6 (Imazethapyr @ 75 g *a.i.* ha^{-1} at 15 DAS), T_7 (Imazethapyr @ 100 g *a.i.* ha^{-1} at 25 DAS). The highest number of root nodule T_7 (21.83) and maximum dry weight of root nodule (mg) T_7 (15.50). Maximum nutrients (N, P and K) uptake by crop Treatment Two hand weeding at 20 DAS and 40 DAS are (43.87, 7.37 and 23.17 kg ha^{-1}) followed by Imazethapyr @ 100 g *a.i.* ha^{-1} at 25 DAS (39.80, 6.77 and 21.67 kg ha^{-1}) and highest nutrient depletion weedy chek treatment. In irrigated condition high weed infection in blackgram crop. This research find out suitable dose and time of imazethapyr in irrigated blackgram.

Keywords: Blackgram, Uptake, Depletion, Imazethapyr.

INTRODUCTION

The global over, blackgram is mostly planted in tropical and subtropical regions for grains, green manuring, fodder, and forage as a single crop, intercropping, mixed crops, and sequential cropping systems. After chickpea and pigeonpea, uradbean is the third most significant and commonly grown pulse crop in India. It is possible to grow it both in the kharif and summer seasons. Due to its short growing season, it blends nicely with conventional rice-wheat cropping systems and brings in extra money for farmers. As a leguminous crop, it contributes significantly to nitrogen fixation, ranging from 20 to 80 kg/ha (Hayat *et al.*, 2008), enhancing system sustainability. Weed infestation is one of the main issues restricting urdbean cultivation and results in a 43.2–64.1% yield loss (Rathi *et al*., 2004). Weeds can reduce the grain production of blackgram by 41.6 to 64.1%, depending on their kind, density, and length of presence (Chand *et al.*, 2004; Singh, 2011). According to (Vivek *et al.*, 2008), the key window for crop-weed competition in blackgram typically occurs between 15 and 45 days after sowing (DAS). The grain production of urdbean is reduced by 50–70% as a result of competition with weeds. To get high yields of urdbean, weed eradication at the right time and with the right technique is crucial. During the busiest times of sowing and harvesting, the traditional practise of hand weeding necessitates a greater reliance on personnel and is therefore more expensive. The only remaining effective tool under such situations is the use of herbicides to manage weeds because timely weeding is crucial to minimizing yield losses. Chemical weed management in urdbean has been proven to be just as effective as manual and mechanical eradication, with additional benefits of labour cost savings over manual eradication of weeds (Tiwari *et al.*, 2018). Numerous pre and post-emergence herbicides have already found a home in the urdbean cultivation package for suppressing weeds. Due to the aforementioned facts, the current experiment was conducted to evaluate the effectiveness of herbicidal weed management in providing control over urdbean.

MATERIALS AND METHOD

The field experiment, which included seven weed control treatments that were duplicated three times, was

carried out in the agronomy farm at the school of agricultural sciences and rural development of Nagaland University during the summer of 2022. The experiment's design used a randomised block layout. The experimental field separated into three equal parts and each part divided into seven equal plots measuring 4.5m × 3m and maintained 0.2m spacing between the plots. Altogether there are 21 plots and in each replication the treatments area allotted randomly by adopting randomization principle.

Soil condition. Red soil with a clayey loam texture was discovered in the trial field. It was also well drained. Using a soil auger, soil samples were drawn at random from a depth of 0 to 15 cm in order to determine the soil's fertility state. The findings of the analysis of the soil samples, which followed proper mining, drying, grinding, and sieving, are shown in Table 1.

Table 1: Initial fertility status of the experiment plot.

Parameters	Value	Status	Method employed
Soil Ph	4.9	Acidic	Potentiometric method: soil to water ratio of 1:2 (Baruah and Barthakur 1997)
Soil organic carbon (%)	1.67	High	Chromic titrimetric determination (Walkley and Black method 1976)
Available N (kg ha^{-1})	282.2	Medium	Alkaline Potassium Permagnate method (Subbiah and Asija 1956)
Available P_2O_5 (kg ha^{-1})	17.22	Medium	Bray's No. 1 method (Brays and Kurtz 1945)
Available K_2O (kg ha^{-1})	172.6	Medium	Neutural Normal Ammonium Method (Baruah and Barthakur 1997)

At 25 and 50 DAS, the total number of root nodules in $plant^{1}$ was counted. Five plants were carefully uprooted at random from each plot's sample rows. Water washed away the soil mass that contained the plants' roots, and the total number of nodules was determined. Total nodules per plant were counted using the mean value.

root nodules $plant^{1}$ total dry weight, as measured at 25 and 50 DAS. Five plants were carefully uprooted at random from each plot's sample rows. Water was used to wash away the soil mass that contained the plants' roots, separating the root nodules from the root, before it was dried. As the total dry weight of root nodules per plant, the mean value was noted.

In order to calculate the protein content of grains, nitrogen concentration in grains was multiplied by a factor of 6.25 (A.O.A.C., 1960).

The plant material i.e. the seed and stover were dried under the sun followed by oven drying. It was than powdered and kept in polythene bags and labelled accordingly.

The uptake of nutrient was computed as follow:

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{\text{Nutrient content (\%)} \times \text{ yield (kg ha}^{-1})}{100}$$

The seed and stover sample were digested with concentrated sulphuric acid in presence of digestion mixture. Nitrogen in plant samples was ascertained using the Black (1965) reported modified Kjeldhal technique.

Total phosphorus was determined by wet digestion method. The seed and stover samples separately di-acid mixture *i.e.* (HNO_3: HCL_4: 3:1) (Baruah and Barthakur 1999). The Vanadomolybdate yellow colour method was used to calculate the total phosphorus in plant sample.

By using a digestion procedure, the total potassium content of both seed and stover was calculated. By using a di-acid mixture, the samples were individually digested (Baruah and Barthakur 1999). According to Chapman and Pratt (1961), a flame photometer was used to measure the total amount of potassium.

RESULTS AND DISCUSSION

Number of root nodules $plant^{-1}$. The data on number of root nodules $plant^{1}$ was recorded and the effects by different treatments are presented in Table 2.

There was a significant effect on number of root nodules $plant^{-1}$ due to different weed management treatments. The highest number of root nodules $plant^{-1}$ was recorded in T_6 (9.03) at 25 DAS significantly superior of the other treatments.

At 50 DAS maximum root nodule T_7 (21.83) which was at par with T_6 (21.27), T_2 (20.30), which was significantly superior of other. Due to enhanced growth characteristics, the crop was able to accumulate and transport more photosynthesis, increasing the number and dry weight of (Choudhary *et al*., 2012) and similar finding reported (Aggarwal *et al*., 2014).

Dry weight of root nodules $plant^{-1}$ (mg). The data on dry weight of root nodules plant was recorded and the effects by different treatments are presented in Table 2.

There was a significant effect on weight of root nodules $plan^{-1}$ due to different weed management treatments. The maximum weight of root nodules $plant^{-1}$ was recorded in T_6 (9.03) at 25 DAS significantly superior of other treatments.

At 50 DAS maximum root nodule T_7 (15.50) which was at par with T_6 (15.13), T_2 (14.33), was noticeably better than the other treatments because of better growth characteristics that led to the crop accumulating and transporting more photosynthesis, increasing the amount and dry weight of (Choudhary *et al*., 2012) and similar finding reported (Aggarwal *et al*., 2014).

Table 2: Effect of dose and time of imazethapyr on number of root nodule plant^{-1} and dry weight of root nodule plant^{-1}

Treatment	Number of root nodule plant^{-1}		Dry weight of root nodule plant^{-1} (mg)	
	25 DAS	50 DAS	25 DAS	50 DAS
T_1 - Weedy check	5.20	13.37	5.83	9.03
T_2 - Two hand weeding @ 20 DAS and 40 DAS	9.00	20.30	7.60	14.33
T_3 - Imazethapyr @ 50 g *a.i.* ha^{-1} at 10 DAS	7.47	14.07	5.77	10.00
T_4 - Imazethapyr @ 75 g *a.i.* ha^{-1} at 10 DAS	8.13	14.53	5.80	10.83
T_5 - Imazethapyr @ 50 g *a.i.* ha^{-1} at 15 DAS	8.53	17.13	6.33	12.27
T_6 - Imazethapyr @ 75 g *a.i.* ha^{-1} at 15 DAS	11.40	21.27	9.20	15.13
T_7 - Imazethapyr @ 100 g *a.i.* ha^{-1} at 25 DAS	5.63	21.83	5.73	15..50
CD	1.32	3.87	1.11	1.44

Protein content in seed. The effects of various treatments, including imazethapyr, on the protein content of seeds are shown in Table 3.

The various weed control techniques had an impact on the protein content of seeds. Protein content in seed was highest in herbicidal treatment Imazethapyr @ 100 g *a.i.* ha^{-1} at 25 DAS (24.27%) followed by Two hand weeding @ 20 DAS and 40 DAS (24.33 %) and lowest in weedy check (21.67 %).

Nitrogen, Phosphorus, and potassium uptake by crop (kg ha^{-1}). The data pertaining to the effect of different treatments on NPK uptake by plant (kg ha^{-1}) are presented in Table 3.

Highest nitrogen uptake by plant was recorded in two hand weeding @ 20 and 40 DAS (43.87 kg ha^{-1}) among the herbicide application plot maximum nutrient uptake T_7 (39.80) which was et par with T_6 (37.93) which was significantly superior rest of the treatments, T_1 weedy check(control) The minimum nitrogen uptake was recorded (20.70 kg ha^{-1}).

Highest phosphorus uptake by plant was recorded in two hand weeding (7.37) and among herbicide treatment T_7 (6.77) and at par with T_6 (6.17) significantly superior rest of the treatments. Weedy check (control) minimum phosphorus uptake (4.47) was recorded.

Highest potassium uptake by plant was recorded in two hand weeding (23.17) and in herbicide treatments maximum potassium uptake T_7 (21.67) which was at par with T_6 (20.27) significantly superior over the other treatments.

Higher nutrient content uptake by crop due to in weed free similar finding reported Komal *et al*. (2015); Tripathy *et al*. (2012).

Nitrogen, Phosphorus, and potassium depletion by Weeds (kg ha^{-1}). The data pertaining to the effect of different treatments on NPK depletion by weeds (kg ha^{-1}) are presented in Table 3.

Table 3: Effect of dose and time of imazethapyr on seed protein content (%), Nutrient uptake thorough crop and depletion by weeds.

Treatment	Protein content (%)	Nutrient depletion by weed (kg ha^{-1})			Nutrient depletion by weed (kg ha^{-1})		
		N	P	K	N	P	K
Weedy check	21.67	20.70	4.47	13.60	26.97	4.30	19.43
Two hand weeding @ 20 DAS and 40 DAS	24.33	43.87	7.37	23.17	0.94	0.27	0.69
Imazethapyr @ 50 g *a.i.* ha^{-1} at 10 DAS	23.23	27.53	5.43	18.33	12.80	2.30	8.23
Imazethapyr @ 75 g *a.i.* ha^{-1} at 10 DAS	23.43	29.14	5.57	18.97	11.97	2.23	7.67
Imazethapyr @ 50 g *a.i.* ha^{-1} at 15 DAS	23.30	33.60	5.80	19.67	11.70	1.96	6.60
Imazethapyr @ 75 g *a.i.* ha^{-1} at 15 DAS	23.77	37.93	6.17	20.27	10.83	1.64	5.67
Imazethapyr @ 100 g *a.i.* ha^{-1} at 25 DAS	24.27	39.80	6.77	21.67	8.63	1.37	5.13
CD (0.05)	1.74	2.37	0.85	1.94	3.14	0.90	1.74

Highest nitrogen depletion by weeds was recorded in treatment weedy check (26.97 kg ha^{-1}) and lowest in two hand weeding @ 20 and 40 DAS (0.94 kg ha^{-1}) followed by T_7 Treatment imazethapyr @ 100 g *a.i.* ha^{-1} at 25 DAS (8.63 kg ha^{-1}) than T_6 Treatment imazethapyr @ 75 g *a.i.* ha^{-1} at 25 DAS (10.83 kg ha^{-1}).

Highest phosphorus depletion by weeds was recorded in treatment weedy check (4.30 kg ha^{-1}) and lowest in two hand weeding @ 20 and 40 DAS (0.27 kg ha^{-1}) followed by T_7 Treatment imazethapyr @ 100 g *a.i.* ha^{-1} at 25 DAS (6.77 kg ha^{-1}) than T_6 Treatment imazethapyr @ 75 g *a.i.* ha^{-1} at 25 DAS (6.17 kg ha^{-1}).

Highest potassium depletion by weeds was recorded in treatment weedy check (19.43 kg ha^{-1}) and lowest in two hand weeding @ 20 and 40 DAS (0.69 kg ha^{-1}) followed by T_7 Treatment imazethapyr @ 100 g *a.i.* ha^{-1} at 25 DAS (5.13 kg ha^{-1}) than T_6 Treatment imazethapyr @ 75 g *a.i.* ha^{-1} at 25 DAS (5.67 kg ha^{-1}). In weedy check plots, where weeds were not properly controlled, the highest levels of N, P, and K depletion by weeds were observed (Singh *et al.*, 2020). Due to the crop producing more dry matter and having correspondingly greater nutrient levels in these treatments, as revealed by Chhodavadia *et al*. (2013), there is little to no weed competition for the uptake of N, P and K.

CONCLUSIONS

Different weed control techniques had a considerable impact on the quantity of root nodules in $plant^{-1}$. The lowest root nodule and root dry weight was found in weedy check, while the highest were found in 50 DAS imazethapyr @ 100 g *a.i.* ha^{-1} at 25. The best results were obtained with the herbicide treatments Imazethapyr 100 g *a.i.* ha^{-1} at 25 DAS and two-hand weeding at 20 and 40 DAS, which maximised crop nutrient uptake.

FUTURE SCOPE

Imazethapyr is an emerging post-emergence (PoE) herbicide for Pulses (blackgram, Greengram and Soyabean). Weed management in blackgram through imazethapyr is one of the most efficient ways to improve its yield.

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