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The Response of Banana Shoot Extract on Lentil Growth, Yield Components and Yield

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A b s t r a c t

A field experiment was conducted at the Agronomy research field, Department of Agronomy and Agricultural Extension, University of Rajshahi, Rajshahi, during the period from 2nd December 2018 to 21st March 2019 to find out the effects of shoot extract of banana on the growth and yield of lentil. The experiment consists of three Banana shoot extracts treatments *i.e.* T_0= No Banana shoot extracts treatment (control), T_1= spraying with 50% of Banana shoot extracts, and T_2= spraying with 100% of Banana shoot extracts spray solution and two lentil varieties *i.e.* BARI masur3 (V_1) and BARI masur6 (V_2). The experiment was laid out in a Randomized Complete Block Design with three replications. The research result revealed that BARI masur6 produced maximum plant height (53.22 cm), branch number(20.40), total dry matter (10.33 g), pod plant^{-1}(69.64), 1000-grain weight (19.22 g), grain yield (1.99 t ha^{-1}), stover yield (6.51 t ha^{-1}), biological yield (8.49 t ha^{-1}). Most of the yield components and yield were significantly influenced by Banana shoot water extract treatment. The maximum plant height (11.17 cm), branch number(21.69), total dry matter (3.68 g), pod plant^{-1} (70.47), 1000-grain weight (19.53 g), grain yield (2.03 t ha^{-1}), stover yield (6.86 t ha^{-1}), biological yield (8.89 t ha^{-1}) were observed in T_2, and the lowest were observed in T_0. The effect of interaction between lentil varieties and Banana shoot extract treatment was non-significant, although maximum grain yield (2.16 t ha^{-1}), stover yield (7.38 t ha^{-1}), biological yield (9.55 t ha^{-1}) was recorded in the combination of V_2 with T_2.

Keywords: Lentil growth, Banana Shoot Extract, Lentil Yield.

Introduction

Recently plant exudates from different parts of plants have been used to check whether the exudates contain any growth promoter or toxic chemicals through bioassay (Sola *et al.*,2019). Many researchers have recommended replacing the old rhizomes of mother plants for better yield in ratooned bananas. Recently, leftover residues of sugarcane (ratooning) (Matsuoka *et al*.,2017), rice (Uga*et al.*, 2013), and many other crops have been reported to cause growth inhibition in the succeeding crops. Many inhibitory chemicals have been identified from the leftover residues of these crops. Thus, the intoxication effects of the banana plant residues on the growth and yield of the ratooned crop cannot be fully ignored. Extracts from different parts of banana plants may contain some toxic chemicals which may cause growth and yield reduction in rationed bananas or other crops. However, water extracts of banana shoot tips contain a large amount of auxin, which may enhance the growth and yield of other crops but has not been discussed previously.

The lentil (*Lens culinarisL*.) is an edible pulse/bean. It is a bushy annual plant of the legume family, grown for its lens-shaped seeds. The sowing time of lentils is mid-October to mid-November, and harvesting time is mid-February to mid-March. Lentils are an essential source of inexpensive protein in many parts of the world, especially in West Asia and the Indian subcontinent. In Bangladesh, Lentil is the second most important pulse crop in terms of area (3, 82,224 acres) and production (1, 68,827 M. Ton), but it ranks the highest in consumer preference and total consumption. Lentil research was initiated in the early 1950s but was confined to collecting and evaluating local germplasm. The major lentil-growing districts are greater Faridpur, Jessore, Kustia, Pabna, and Rajshahi. Lentil is grown mainly as a mono-crop in Bangladesh, but mixed cropping and intercropping with wheat, mustard, linseed, sugarcane, and other

crops is practiced in some areas (Shrestha *et al*., 2016). More than half of the lentil in Bangladesh is grown mixed and intercropped with other winter crops, such as wheat, mustard, linseed, barley, and sugarcane.

Lentils contain sufficient levels of all essential amino acids, including methionine and cysteine (Kahraman*et al.*, 2016). Lentils also contain dietary fiber, folate, vitamin B_1, and minerals. United States Department of Agronomy health magazine has selected lentils as one of the five healthiest foods. (Fabbri and Crosby, 2016)

The productivity of lentils in Bangladesh is still very low compared with other neighboring countries. Agricultural researchers have recently been interested in improving crop growth and productivity using natural phytohormones. Among the phytohormones, auxins are the widely used phytohormone that enhances crop growth. Considering the above context, the present experiment was designed with the following objectives:

a) To identify the effect of banana shoot extract on growth, yield components, and yield of lentils.

b) To justify the varietal differences of BARI masur3 and BARI masur6 subjected to the application of banana shoot extract.

c) To find out the interaction effect of banana shoot extract concentration and lentil varieties.

Materials and Methods

The experiment was conducted at Agronomy Field Laboratory, Department of Agronomy and Agricultural Extension, Rajshahi University, Rajshahi, from November 2018 to April 2019 to study the effects of the banana shoot (*Musa sp*.) extract on growth development, yield, and yield components of lentil. The experimental field was situated on the western side of the Agronomy and Agricultural Extension Department. Geographically the experimental field was located at $24^0$22'36'' N latitude and $88^0$38' 36''E longitude at an elevation of 20m above the sea level belonging to the agro-ecological zone (AEZ-11). The experimental field was a high land with sandy loam textured soil having a pH value of 8.1. The experimental plot was of the Department of Agronomy and Agricultural Extension of Rajshahi University, Rajshahi. The soil was well-drained with moderate permeability. The topsoil was semi-loam and slightly alkaline in reaction. Soil morphological and chemical properties are presented in The experimental field under a subtropical climate characterized by moderately high temperature and heavy rainfall during the *Kharif*season (April to September) and scantly rainfall with moderately low temperature during the *rabi*season (October to March). During the study period, the maximum (34.7°c) and minimum (6.1°c) temperatures have been recorded in March and January. Two modern lentil varieties,*i.e.* (BARI masur3 and BARI masur6) collected from Regional BADC Station, Rajshahi, were used in this experiment. BARI masur3 was rust and stem phylum disease tolerant, BARI masur6 was resistant to rust/STB and tolerated foot rot, moderately resistant to aphids, and both varieties were high yielding. BARI masur3 was released in 1996, and BARI masur6 was released in 2006. These lentil varieties can be cultivated in any part of Bangladesh and are suitable for optimum and late planting conditions.

Experimental Treatments

Two factors are included in this experiment (Factor A and Factor B). Factor A = Lentil varieties,V_1 (BARI masur3) andV_2 (BARI masur6). Factor B = Water extract of Banana plant shoot water extract, T_0 = No spraying of Banana plant shoot water extract, T_1 = 50% of Banana plant shoot water extract spray solution, and T_2 = 100% of Banana plant shoot water extract spray solution. The experiment was laid out in a split-plot design assigning two lentil varieties to the main plot and spraying water extract of the banana shoot to the sub-plot or split-plot. The total number of unit plots in the entire experimental plot was 18 (3×2×3). The unit plot size was $8m^2$ (4m×2m). The sub-plot to sub-plot distance was 1m, and the main plot to main plot distance was 1.5 m.

Preparation of Spray Materials

The Banana (*Musa sp.*) plant shoots were collected from Meherchandi, Rajshahi, on 23rd December 2018. After that, the leaves were thoroughly washed with tap water, followed by washing with sterilized water and blended at 100g banana shoot with 100 ml distilled water. These were filtered through a muslin cloth followed by Whatman No.1 filter paper. This is the method of preparing 100% spray solution. After that, this stock solution was diluted to get 50%. 50% spray solution is mixed with 50ml distilled water to prepare the 50% spray solution. The extracts were used in the experiments on the same day. At 4 pm, the spray solution was sprayed in the experimental field by using a hand sprayer according to the treatment layout. Control plots were similarly sprayed with the same amount of distilled water.

A power tiller was used for the preparation of the experimental field. Then it was exposed to the sunshine for 5/6 days before the next plowing. After that, the land was plowed and cross-plowed and deep plowing were due to obtain good tilth, which was necessary to get a better yield of this crop. Laddering was done to break the soil clods into small pieces, followed by each plowing. All the weeds and stubbles were removed from the experimental field. The plots were spaded one day before planting, and the whole amount of fertilizers was incorporated thoroughly before planting according to the fertilizer recommendation guide (Rashid*et al*.,2021). The soil was treated with insecticides at the time of final plowing. Insecticides Furadan 5G was used @ 8 kg ha^{-1} to protect young plants from the attack of the mole cricket, ants, and cutworms. The following fertilizers were used as a general dose in the experimental plots: Urea: 50 kg ha^{-1}, TSP: 85 kg ha^{-1}, Mop: 35 kg ha^{-1} and Gypsum: 45 kg ha^{-1}. One-third of urea and whole TSP, MoP and Gypsum were applied during final land preparation and thoroughly mixed into the soil. The remaining half of urea was top dressed at first irrigation (CRI stage, 22 DAS) and at least one-third of urea was applied at 2nd irrigation, 50 DAS. Before planting, seeds were treated with Vitavax-200 @ 0.25% of seed weight basis to prevent seeds from the attack of seed-borne as well as from soil-borne diseases and pathogens.

The experimental plot hand-sowed seeds of BARI masur3 and BARI masur6 varieties. Seeds were sown on 2nd December 2018. The row-to-row and plant-to-plant distances were 25 and 4 cm, respectively. Seeds were placed at about 5 cm depth from the soil surface. First weeding was done at 20 DAS and then once a week to keep the plots free from weeds and to keep the soil loose and aerated. The emergence of seedlings was completed within 10 days after sowing. Overcrowded seedlings were thinned out two times. The first thinning was done after 15 days of sowing which is done to remove unhealthy and lineless seedlings. The plot was irrigated one time during the growing period of the crop. The irrigation was applied at 35 DAS (05/01/2019). Drainage was done when necessary by using drainage channels. The research field looked nice with normal green plants. The field was observed from time to time to detect the visual difference among the treatments and any kind of infestation. The experimental crop was not infected with any disease and no fungicide was used. Hairy caterpillars attacked the young plants and accumulated on the lower surface of leaves, where they usually sucked the juice of green leaves. Borers also attacked the pods. They attacked at the early growing stages of seedlings. To control these pests, the infected leaves were removed from the stem and destroyed together with insects by hand picking. Besides, spraying pyriphos controlled these insects. The insecticide was sprayed three times at seven days intervals.

The crop was harvested after 120 days of sowing for data collection when about 80% of the pods attained maturity. The morphological, growth and yield attributes of crop sampling were done at the harvest stage. Data were recorded on $1m^2$ area of the middle portion of each plot. The harvested plants of each treatment were brought to the cleaned threshing floor and separated pods from pants by hand, allowing them to dry well under bright sunlight. After threshing, each plot's grain yields and stover yields were recorded separately. Finally, grain weights were taken from an individual plot basis at the moisture content of 12% and converted into kg ha^{-1}. The yield of dry stover was also taken. At the final harvest, data on some morpho-physiological yield components and yield were also collected.

Statistical procedure

The collected data were analyzed statistically following the analysis of variance (ANOVA) technique and the mean differences were adjudged with Duncan's Multiple Range Test (DMRT) using the statistical computer package program, STATVIEW (Gomez and Gomez, 1984).

Results

Our study evaluated growth, yield and yield contributing characteristics of lentils influenced by the water extract of Banana shoot and lentil variety. Plant heights of two different lentil varieties were measured at 21, 42, 63 and 84 days after sowing (DAS) and presented in Table -1. Two lentil varieties differed significantly at 42 and 84 DAS. At 21 DAS, the highest plant height (11.19 cm) was observed in V_2(BARI masur6) and the lowest plant height (10.71cm) was obtained in V_1 (BARI masur3). At 42 DAS, the highest plant height (34.18cm) was obtained in V_2 which was significantly 10.09% higher than V_1. At 63 DAS, the highest plant height (41.80 cm) was obtained in V_2 and the lowest plant height (39.37 cm) was obtained in V_1. Finally, at 84 DAS, the highest plant height (53.22 cm) was obtained in V_2 and the lowest plant height (47.36 cm) was obtained in V_1. The plant height of lentils was reduced significantly by spraying water extract of banana shots at 42 and 84 DAS (Table 1). At 21 DAS, the highest plant height (11.17 cm) was observed both in T_2, while the lowest value (10.62 cm) was obtained at T_1. At 42 DAS, the highest plant height (34.78 cm) was observed in T_2, which reduced slightly (7.13%) in T_1 but significantly by 15.32% in T_0. At 63 DAS highest plant height (41.92 cm) was observed in T_2, which was reduced by 2.98 and6.56% in T_1 and T_0, respectively. At 84 DAS highest plant height (55.09cm) was observed in T_2, which was reduced marginally by 8.42% in T_1 and significantly by 15.88% in T_0. The plant height of lentil was not differed significantly due to the interaction between varieties and water extract of the banana shoot at all observations (21, 42, 63 and 84 DAS) (Table 1). At 21 DAS, the highest plant height (11.22 cm) was observed in the interaction of V_2 with T_2 and the lowest (10.12cm) was in V_1T_1. At 42 DAS, the highest plant height (36.11 cm) was found in the combination of V_2 with T_2 and the lowest (27.11 cm) was in V_1T_0. At 63 DAS, the highest plant height (42.95cm) was observed in V_2 with T_2 and the lowest (37.67 cm) was in V_1T_0. At 84 DAS, the tallest plant (58.44 cm) was obtained from V_2 with T_2 and the shortest plant (44.18 cm) was observed in V_1T_0.

The number of branches of lentil varieties counted on 21, 42, 63 and 84 days after sowing (DAS) are presented in (Table 2). The number of branches differed significantly at 21, 42, 63 and 84 DAS. At 21 DAS, the highest number of branches (5.74) was observed in V_2 and the lowest number of branches (4.78) was obtained in V_1. At 42 DAS, the highest number of branches (9.79) was obtained in V_2 and the lowest number of branches (8.29) was observed in V_1. At 63 DAS, the highest number of branches (13.63) was obtained in V_2 and the lowest number of branches (10.37) was in V_1. At 84 DAS, The highest number of branches per plant (20.40) was observed in V_2 and the lowest number of branches per plant (15.17) was observed in V_1. Spraying of

Table 1. Variation in plant height of lentil varieties subjected to application of the banana shoot extract spray solution.

Lentil varieties	Plant height (cm)			
	21 DAS	42 DAS	63 DAS	84 DAS
V_1	10.71	30.73b	39.37	47.36b
V_2	11.19	34.18a	41.8	53.22a
LS	NS	0.01	NS	0.05
Banana shoot extract spray treatments				
T_0	11.06	29.55b	39.17	46.34b
T_1	10.62	33.02ab	40.67	50.45ab
T_2	11.17	34.78a	41.92	55.09a
LS	NS	0.01	NS	0.05
Interaction effects				
V_1T_0	10.89	27.11	37.67	44.18
V_1T_1	10.12	31.61	39.56	46.34
V_1T_2	11.11	33.45	40.89	51.75
V_2T_0	11.23	31.98	40.67	48.66
V_2T_1	11.12	34.43	41.78	54.56
V_2T_2	11.22	36.11	42.95	58.44
LS	NS	NS	NS	NS
CV%	13.44	5.04	6.7	6.46

NS= Non-significant, CV= Co-efficient of variation, LS= Level of significance, DAS= Day's after sowing, V_1 =Variety 1 (BARI masur3), V_2 = Variety 2 (BARI masur6), T_0 = No application of banana shoot extract spray (control), T_1=50% of banana shoot extracts spray solution andT_2 =100% of banana shoot extracts spray.

Table 3: Variation in yield components and yield of lentil varieties subjected to the application of the banana shoot extract spray solution.

Lentil varieties	Number of pods plant^{-1}	Number of effective pods plant^{-1}	Number of non-effective pods plant^{-1}	1000 grain weight	Grain yield (t/ ha)	Stover yield(t/ ha)	Biological yield(t/ ha)	Harvest index (%)
V1	62.62	55.13	7.49	18.01	1.54	4.9	6.44	23.96
V2	69.64	63.35	6.29	19.22	1.99	6.51	8.49	23.56
LS	0.01	0.01	0.05	0.01	0.01	0.01	0.01	NS
Banana shoot extract spray treatments								
T_0	61.59	54.41	7.18	17.75	1.48	4.69	6.17	23.81
T_1	66.34	59.12	7.22	18.57	1.79	5.56	7.36	24.57
T_2	70.47	64.2	6.27	19.53	2.03	6.86	8.89	22.9
LS	0.01	0.01	NS	0.01	0.01	0.01	0.01	NS
Interaction effect								
V_1T_0	58.12	50.63	7.49	17.37	1.17	3.88	5.06	23.11
V_1T_1	62.22	54.84	7.38	17.87	1.55	4.49	6.04	25.67
V_1T_2	67.53	59.93	7.59	18.8	1.9	6.33	8.23	23.11
V_2T_0	65.05	58.19	6.86	18.13	1.78	5.5	7.28	24.51
V_2T_1	70.46	63.39	7.06	19.27	2.03	6.63	8.67	23.47
V_2T_2	73.41	68.47	4.94	20.27	2.16	7.38	9.55	22.69
LS	NS	NS	NS	NS	NS	NS	NS	NS
CV%	2.56	2.94	15.6	1.21	6.22	6.9	6.21	5.6

NS= Non-significant, CV= Co-efficient of variation, LS= Level of significance, DAS=Day's after sowing, V_1 =Variety 1 (BARI masur3), V_2 = Variety 2 (BARI masur6), T_0 = No application of banana shoot extract spray (control), T_1=50% of banana shoot extracts spray solution and T_2 =100% of banana shoot extracts spray.

Banana shoot extract showed significant variation in the number of branches of lentils at 21, 42, 63 and 84 DAS (Table 2). At 21 DAS, the highest number of branches (5.50) was observed in T_0 and the lowest number of branches (5.00) was obtained at T_2. At 42 DAS highest number of branches (10.11) was observed in T_2, which was10.38 and 24.23% higher than T_1 and T_0 respectively. At 63 DAS, the highest number of branches (14.19) was observed in T_2 and the lowest number of branches (10.24) was observed in T_0. At 84 DAS, The highest number of branches per plant (21.69) was recorded in T_2 and the lowest number of branches per plant (14.31) was observed in T_0. The number of branches was not statistically significant due to the interaction between varieties and water extract of the banana shoot at all observations (21, 42, 63 and 84 DAS) (Table 2). At 21 DAS, the highest number of branches (6.22) was observed in the interaction of V_2 with T_0 and the lowest (4.78) was in V_1 with T_0. At 42 DAS, the highest number of branches (10.78) was found in the combination of V_2 with T_2 and the lowest (7.22) was in V_1 with T_0. At 63 DAS, the highest number of branches (17.16) was observed in V_2 with T_2 and the lowest (12.34) was in V_1 with T_0. At 84 DAS, the Maximum number of branches per plant (24.63) was recorded in the combination of V_2 with T_2 and the minimum (12.34) was found in V_1 withT_0.

Plant dry matter production differed s significantly between the lentil varieties (Table 2). At 21 DAS, the highest TDM (0.40g plant^{-1}) was observed in V_1 and the lowest TDM (0.39g plant^{-1}) was obtained at V_2. At 42 DAS, the highest TDM of 3.44 g plant^{-1}was observed at V_2 and the lowest (2.71 g plant^{-1}) was observed at V_1. At 63 DAS, the highest TDM (6.83 g plant^{-1}) was obtained in V_2 and the lowest TDM (5.22 g plant^{-1}) was obtained in V_1. At 84 DAS, the highest TDM (10.33 g plant^{-1}) was obtained at V_2 and the lowest TDM (8.19 g plant^{-1}) was obtained at V_1. The main effect of spraying water extract from the banana shoots on plant dry weight was significant except for 21 DAS (Table 2). At 21 DAS, the highest TDM (0.42g plant^{-1}) was observed in T_0 and the lowest TDM (0.37 g plant^{-1}) was in T_2. At 42 DAS, the highest TDM (3.68 g plant^{-1}) was observed in T_2 and the lowest TDM (2.57g plant^{-1}) was obtained in T_0. At 63 DAS, the highest TDM (6.93 g plant^{-1}) was observed in T_2 and the lowest TDM (4.98 g plant^{-1}) was in T_0. At 84 DAS, the highest TDM (10.77 g plant^{-1}) was observed in T_2 and the lowest TDM (7.92 g plant^{-1}) was in T_0. No significant effects in TDM were observed in the interaction between variety and water extract of Banana shoots on lentil (Table 2). At 21 DAS, the highest TDM (0.47 g plant^{-1}) was observed in V_1T_1 and the lowest value (0.30 g plant^{-1}) was observed in V_1T_2. At 42 DAS, the highest TDM (4.07g plant^{-1}) was observed in V_2T_2 and the lowest value (2,27g plant^{-1}) was observed in V_1T_0. At 63 DAS, the highest TDM (7.73 g plant^{-1}) was observed in V_2T_2 and the lowest value (4.20 g plant^{-1}) was observed in V_1T_0. At 84 DAS, the highest TDM (12.00 g plant^{-1}) was observed in V_2T_2 and the lowest value (6.93 g plant^{-1}) was observed in V_1T_0.

Both lentil varieties differed significantly in respect of the number of pods per plant (Table 3). The highest pod number per plant (69.64) was observed in V_2 and the lowest number per plant (62.62) was observed in V_1.Significant differences were observed in the number of pods per plant (Table3). The highest number of pods per plant (70.47) was recorded in T_2,and the lowest number of pods per plant (61.59) was recorded in T_0. Nosignificant interaction between varieties and spraying water extract of Banana shoots was observed in the number of pods per plant (Table 3). The maximum number of pods per plant (73.41) was recorded in the combination of $V_2$with T_2, and the minimum (58.12) was found in V_1T_0. Both lentil varieties differed significantly in respect of the number of effective pods per plant (Table 3). The highest number of effective pods per plant (63.35) was observed in V_2, which was 12.97% higher than that in V_1. Significant differences were observed in the number of effective pods per plant for spraying water extract from Banana shoots on lentils (Table 3). The highest number of effective pods per plant (64.20) was recorded in T_2 which was7.91 and 15.24% higher than T_1 and T_0respectively. No significant interaction between

varieties and spraying water extract of the banana shoot was observed in the number of effective pods per plant (Table3). The maximum number of effective pods per plant (68.47) was recorded in the combination of V_2 with T_2 and the minimum number (50.63) was found in V_1T_0. Both lentil varieties differed significantly in respect of the number of non-effective pods per plant (Table 3). The highest number of non-effective pods per plant (7.49) was observed in V_1 and the lowest number of non-effective pods per plant (6.29) was observed in V_2. Significant differences were observed in the number of non-effective pods per plant for spraying water extract from Banana shoots on lentils. (Table 3). The lowest number of non-effective pods per plant (6.27) was recorded in T_2, while the highest number (7.22) was observed in T_1.No significant interaction between varieties and spraying water extract of Banana shoot were observed in the number of non-effective pods per plant (Table 3). The lowest number of non-effective pods per plant (4.94) was found in V_2T_2 and the highest (7.59) was recorded in the combination of V_1T_2.Varieties differed significantly in 1000 grains weight of lentil. The highest 1000 grains weight (19.22 g) was observed from V_2, which was 6.29% higher than V_1 (Table 3).Significant differences in 1000 grains weight were observed for spraying water extract of banana shoots (Table 3). The maximum 1000 grains weight (19.53 g) was recorded in T_2, which was reduced slightly by 4.91 and 9.11% in T_1 and T_0, respectively.No significant interaction between varieties and water extract of Banana shoot was observed in 1000 grains weight of lentil (Table 3). A maximum 1000 grains weight (20.27 g) was found in the combination of V_2 with T_2 and the minimum (17.37 g) was observed in V_1 with T_0.Both lentil varieties differed significantly in grain yield. The highest grain yield (1.99 t ha^{-1}) was observed in V2 (BARI masur6), which was 22.61% higher than V1 (BARI masur3) (Table 3). Grain yield showed significant differences for spraying water extract of Banana shoots (Table 3). The maximum grain yield (2.03 t ha^{-1}) was recorded in T_2, which was 11.82 and 27.09% higher than T_1 and T_0, respectively. No significant interaction was found between varieties and spraying water extract of the banana shoot in the grain yield of lentils (Table 3). Maximum grain yield (2.16 t ha^{-1}) was observed in the combination of V_2 with T_2 and minimum (1.17 t ha^{-1}) was observed in V_1 with T_0.Crop growth and productivity are enhanced by different phytohormones (Jogawat*et al.,*2021). Banana shoot contains a large amount of auxin (Hu W *et al.,* 2015).Auxins promote stem elongation and inhibit the growth of lateral buds (maintains apical dominance). Thus shoot extract of bananas enhances plant growth and productivity (Roy *et al*.,2006).Significant differences were found between the two lentil varieties in stover yield. Maximum stover yield (6.51 t ha^{-1}) was observed in V_2 and minimum (4.90 t ha^{-1}) was observed in V_1 (Table 3).Stover yield showed significant differences due to spraying water extract of the banana shoot(Table3). The maximum Stover yield (6.86 t ha^{-1}) was recorded in T_2, which was 18.95 and 31.63% higher than T_1 and T_0,respectively.No significant interaction was found between varieties and spraying water extract of banana shoots in the stover yield of lentils (Table 3). The highest stover yield (7.38t ha^{-1}) was observed in the combination of V_2 with T_2 and the lowest (3.88 t ha^{-1}) was in V_1 with T_0. Significant differences were found between the two varieties in biological yield. Maximum biological yield (8.49 t ha-1) was observed in V_2 which was 24.14% higher than that in V_1 (Table 3).Significant differences were observed in the lentil's biological yield for spraying Banana shoot water extract (Table 3). The highest biological yield (8.89 t ha^{-1}) was recorded in T_2, which was 17.21 and 30.59% higher than T_1 and T_0, respectively.

No significant interaction between varieties and spraying water extract of Banana shoots was observed in the biological yield of lentils **(**Table 3**)**. The highest biological yield (9.55 t ha^{-1}) was observed in the combination of V_2 with T_2 and the lowest (5.06 t ha^{-1}) in V_1 with T_0. Both lentil varieties differed non-significantly in harvest index (HI). Maximum HI (23.96%) was observed in V_1 and the minimum (23.56%) was found in V_2 **(**Table 3**)**. Harvest index was not statistically significant due to spraying water extract of the banana shoot on lentils **(**Table 3**)**. The maximum HI (24.57%) was recorded in T_1 and the minimum HI (22.90%) was recorded in T_2. No significant interaction was observed between varieties and spraying water extract of Banana shoot in harvest index (HI) (Table 3). The Maximum HI (25.67%) was observed in the combination of V_1 with T_1 and the minimum (22.69%) in V_2 with T_2.

Discussion

A field experiment was conducted at the Agronomy research field, Department of Agronomy and Agricultural Extension, University of Rajshahi, Rajshahi, during the period from 2nd December 2018 to 21st March 2019 to find out the effects of shoot extract of banana on the growth and yield of lentil. The experiment consists of three Banana shoot extracts treatments i.e T_0= No Banana shoot extracts treatment (control), T_1= spraying with 50% of Banana shoot extracts and T_2= spraying with 100% of Banana shoot extracts spray solution and two lentil varieties i.e BARI masur3 (V_1) and BARI masur6 (V_2). The experiment was laid out in a Randomized Complete Block Design with three replications. The unit plot size was 1m^2 (1m×1m). The plots were fertilized with urea (50 kg ha^{-1}), triple super phosphate (85 kg ha $^{-1}$), muriate of potash (35 kg ha^{-1}) and gypsum (45 kg ha^{-1}). Lentil seeds were sown in line on 2nd December 2018. Intercultural operations were done when required. The crop was harvested at full maturity. The collected data were analyzed statistically following the analysis of variance (ANOVA) technique using the statistical computer package program, STATVIEW.

The research result revealed that BARI masur6 produced maximum plant height (53.22 cm), branch number(20.40), total dry matter (10.33 g), pod plant^{-1}(69.64), 1000-grain weight (19.22 g), grain yield (1.99 t ha^{-1}), stover yield (6.51 t ha^{-1}), biological yield (8.49 t ha^{-1}).

Most of the yield components and yield were significantly influenced by Banana shoot water extract treatment. The maximum plant height (11.17 cm), branch number(21.69), total dry matter (3.68 g), pod plant^{-1} (70.47), 1000-grain weight (19.53 g), grain yield (2.03 t ha^{-1}), stover yield (6.86 t ha^{-1}), biological yield (8.89 t ha^{-1}) were observed in T_2 and the minimum was observed in T_0.

The effect of interaction between lentil varieties and Banana shoot extract treatment was non-significant, although maximum grain yield (2.16 t ha^{-1}), stover yield (7.38 t ha^{-1}), biological yield (9.55 t ha^{-1}) was recorded in the combination of V_2 with T_2.

Conclusion

From the above study, it can be concluded that the yield performance of BARI masur6 is better than BARI masur3 and the application of banana shoot extract progressively enhances lentil yield. So the use of water extract from Banana shoots is beneficial for the growth and yield of lentils.we also recommend the farmers to use BARI masur6 variety with sparying banana extract to get higher yield for lentil production.

Conflict of interest

Threreis no conflict of interest among the authors.

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