The Bioscan 12(1): 411-414, 2017 (Supplement on Agronomy)
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.com

EFFECT OF FOLIAR APPLICATION OF NUTRIENTS ON NODULATION, YIELD ATTRIBUTES, YIELDS AND QUALITY PARAMETERS OF URDBEAN [*VIGNA MUNGO* (L.) HEPPER]

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KEYWORDS
Borax
Foliar application
Protein
Urea
Urdbean

Received on :
15.10.2016

Accepted on :
18.01.2017

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ABSTRACT
A field experiment was conducted during *kharif* 2014 at N. E. Borlaug Crop Research Centre of Govind Ballabh Pant University of Agriculture andTechnology, Pantnagar to assess the effect of foliar application of nutrients on nodulation, yield attributes, yields and quality parameters of urdbean. The experiment was conducted in RBD (randomized block design) having twelve treatments with three replications. Maximum number of nodules per plant (33.7) and dry weight of nodules per plant (12.6 mg) was recorded in treatment T_{12} (2% Urea + 2 % SSP + 0.1 % Zinc EDTA + 0.2 %B (Borax). Maximum number of pod per plant (66.4), pod length (4.6 cm), number of grains per pod (7.3), 1000-grain weight (41.9 g) and grain yield per plant (8.4 g) were recorded with T_{12}. Maximum grain yield (2280 kg ha^{-1}), highest protein content (23.3%) was recorded in $T_{12.}$

INTRODUCTION

Pulses are the main source of dietary protein, particularly for vegetarians, and contribute about 14 % of the total protein of an average Indian diet. Pulses cover an area of about 23.47 million hectares with an annual production of 19.78 million tonnes, and a productivity of 785 kg/ha in our country (GOI, 2013-14). Among the pulses, urdbean [*Vigna mungo* (L.) Hepper], is an important crop in India. In India, it is widely cultivated throughout the plains and up to mid hills (Singh and Ahlawat, 2005). Urdbean is the fourth most important pulse crop after chickpea, pigeonpea and green gram in India. It contains 48.0% carbohydrates, 22.3% protein, 154 mg calcium, 9.1 mg iron, 1.4 g fat, 0.37 g riboflavin and 0.42 mg thiamin in per 100 g of urdbean (Asaduzzaman *et al*., 2010). All India area, production and productivity of urdbean was 3.11 m ha, 1.90 m tones and 611 kg/ha, respectively, during 2012-13 (Anonymous, 2014). Urdbean is cultivated in different seasons in India, that is in *kharif* (rainy season) as a sole as well as a mixed crop with cereals and pigeonpea, and in *rabi* and *zaid* (spring and summer) mostly as a sole crop and fits well in various multiple and intercropping systems due to its short duration nature.

Regular and balanced use of fertilizers helps to increase the yield of urdbean, and provides consistent profit to the farmers (Bhattacharya *et al., 2004)*. But even today, a large number of farmers are not applying the recommended dose of fertilizer to this crop. As a consequence of technological innovation, farmers have realized the importance of nitrogen, but use of phosphorus and micro-nutrients is still not a common practice (Barel, 1975). Recently the deficiency of sulphur has emerged as a common constraint in several pulses growing areas of the country due to continuous removal from the soil and a little or no addition into the soil (TSI, 2014-15). The deficiency of sulphur in pulses is more deleterious than in the cereals because of higher sulphur requirement. Micronutrients are equally important in plant nutrition as macronutrient. Indian soils have gone deficient especially in zinc and boron. Analyses of soil samples for extractable S and micronutrients was most revealing and showed that 73–95% of the farmers' fields were deficient in sulphur, 70–100% in boron, and 62–94% in zinc (Rego *et al.,* 2007) in Pakistan.

Foliar application of nutrients has been proved to be an important asset in fertilizer application with a specific aim of increasing nutrient availability at the time of need especially in the later stage of plant growth (Kuepper, 2003). Though, the emphasis has been laid on for foliar fertilization of trace elements yet it has repeatedly been observed that the foliar application of macronutrients, too, has a positive impact on plant metabolisms and ultimately on the yield (Fageria *et al.,* 2009). Keeping in view the above fact, the experiment was conducted to assess the effect of foliar application of nutrients on nodulation, yield attributes, yields and quality parameters of urdbean

MATERIALS AND METHODS

An experiment was conducted during *kharif* 2014 at N. E.

Borlaug Crop Research Centre of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (Uttarakhand). The daily temperature during the study period varied between a minimum of 15.5ºC to a maximum of 34.3ºC. The mean annual rainfall is 1400 mm. The soil of the experimental field was a silty clay loam in texture being medium in available nitrogen (264.8 kg/ha) and sulphur (26.8 kg/ha) and low in available boron (0.45 ppm) and zinc (0.40 ppm) but high organic carbon (0.90%) contents with neutral in reaction (pH 7.45). The experiment was laid out in a randomized block design with three replications. There were twelve treatments as follows; T_1 Control (Water Spray), T_2 (2 % urea), T_3 (2 % SSP), T_4 (0.1 % Zinc EDTA), T_5 (0.2 % B (Borax), T_6 (2% Urea + 2 % SSP), T_7 (2% Urea + 0.1 % Zinc EDTA), T_8 (2% Urea + 0.2 % B (Borax), T_9 (2% Urea + 2 % SSP + 0.1 % Zinc EDTA), T_{10} (2% Urea + 2 % SSP + 0.2 % B (Borax), T_{11} (2% Urea + 0.1 % Zinc EDTA + 0.2 % B (Borax) and T_{12} (2% Urea + 2 % SSP + 0.1 % Zinc EDTA + 0.2 % B (Borax). Urdbean, variety Pant U-31 was sown @ 15 kg/ha. The seeds were placed in furrows at a depth of 3-4 cm from soil surface on July 30, 2014. Row to row distance was maintained at 30 cm. The gross plot size was 5.0 m × 3.0 m. A uniform dose of 18 kg N, 48 kg P_2O_5 and 24 kg K_2O/ha was applied as basal through NPK mixture (12:32:16) at the time of sowing. Pre emergence herbicide was done with the help of a hand operated knapsack sprayer fitted with flat-fan nozzle at the time of sowing. One irrigation was given to the crop due to sort of rainfall. During the crop period, a total rainfall of 398.4 mm was received. Harvesting was done in the month of October when most of the (80%) pods turned brown in colour from the net plot (4.0 m × 1.8 m). The growth and yield attributes were recorded from five selected plants in each plot. Protein content in grains at maturity was worked out by multiplying nitrogen percentage of grains at maturity with 6.25. After getting protein content, the protein yield was calculated by multiplying with corresponding oven dried grain yield (kg/ha).

RESULTS AND DISCUSSION

Effect on nodulation

The number of nodules per plant and dry weight of nodules differed significantly due to different foliar nutrient management practices. Maximum number of nodules per plant (33.7) and dry weight of nodules per plant (12.6 mg) was recorded in treatment T_{12} (2% Urea + 2 % SSP + 0.1 % Zinc EDTA + 0.2 % B (Borax) whereas lowest number of nodules per plant (23.7) and dry weight of nodules per plant (12.6 mg) was obtained in control (water spray). It might be due to foliar application which supplied these nutrients easily and rapidly to plant which increased the total number of nodules and dry weight of nodules. Parmar *et al.,* 1999 also suggested the

Table 1: Effect of different foliar nutrient practices on yield attributes and yield of urdbean

Treatment	No. of pods/plant	Pod length(cm)	No. of grains/ pod	1000-grain weight (g)	Grain weight (g/plant)	Grain yield (kg/ha)	Straw yield (kg/ha)
T_1 – Control (Water Spray)	32.4	2.9	4.8	24.6	4.6	1472	1700
T_2 – 2 % Urea	44.4	3.4	6.1	28.8	4.9	1667	2540
T_3 – 2 % SSP	45.5	3.9	6.2	28.9	5.2	1764	2274
T_4 – 0.1 % Zinc EDTA	54.1	4.5	6.9	32.1	6.0	1972	3052
T_5 – 0.2 % B (Borax)	48.1	4.2	6.5	31.6	5.7	1764	2594
T_6 – 2% Urea + 2 % SSP	50.7	4.3	6.6	31.7	6.3	1917	3040
T_7 – 2% Urea + 0.1 % Zinc EDTA	60.5	4.5	7.3	33.6	7.9	2125	3690
T_8 – 2% Urea + 0.2 % B (Borax)	52.6	3.9	6.4	29.7	7.4	1903	3690
T_9 – 2% Urea + 2 % SSP + 0.1 % Zinc EDTA	62.8	4.5	6.9	36.0	8.0	2181	3693
T_{10} – 2% Urea + 2 % SSP + 0.2 % B (Borax)	59.0	4.2	6.6	34.1	7.8	2014	2814
T_{11} – 2% Urea + 0.1 % Zinc EDTA + 0.2 % B (Borax)	65.5	4.5	7.0	40.2	8.1	2225	3765
T_{12} – 2% Urea + 2 % SSP + 0.1 % Zinc EDTA + 0.2 % B (Borax)	66.4	4.6	7.3	41.9	8.4	2280	3780
SEm ±	3.0	0.6	0.2	2.3	0.5	118	233
CD (P = 0.05)	8.8	0.2	0.6	6.7	1.6	347	685

Table 2: Effect of different foliar nutrient practices on nodulation and protein content of urdbean

Treatments	Nodulation at flowering		Protein content(%)	Protein yield (kg/ha)
	Nodules/plant	Nodules dry weight (mg/plant)		
T_1 – Control (Water Spray)	23.7	12.6	21.9	322.0
T_2 – 2 % Urea	26.0	16.4	22.7	379.7
T_3 – 2 % SSP	26.4	16.4	21.7	382.2
T_4 – 0.1 % Zinc EDTA	30.4	17.2	22.0	433.5
T_5 – 0.2 % B (Borax)	27.0	16.2	21.7	383.3
T_6 – 2% Urea + 2 % SSP	27.9	19.1	22.0	421.3
T_7 – 2% Urea + 0.1 % Zinc EDTA	32.4	22.5	22.0	468.3
T_8 – 2% Urea + 0.2 % B (Borax)	28.3	19.0	22.1	419.9
T_9 – 2% Urea + 2 % SSP + 0.1 % Zinc EDTA	33.1	22.4	22.3	486.3
T_{10} – 2% Urea + 2 % SSP + 0.2 % B (Borax)	30.9	20.7	22.0	443.1
T_{11} – 2% Urea + 0.1 % Zinc EDTA + 0.2 % B (Borax)	33.2	26.2	21.9	480.8
T_{12} – 2% Urea + 2 % SSP + 0.1 % Zinc EDTA + 0.2 % B (Borax)	33.7	26.4	23.3	531.8
SEm ±	2.2	0.8	0.38	28.2
CD (P = 0.05)	6.3	2.5	NS	82.6

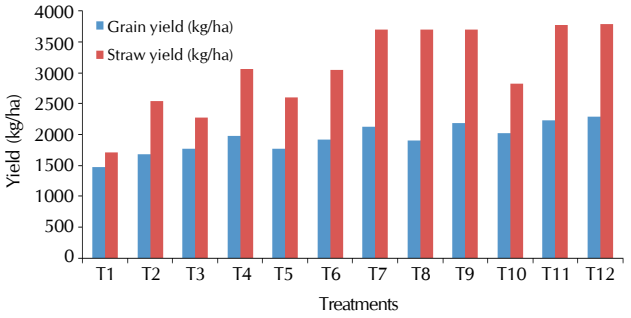

Figure1: Grain and straw yields as influenced by different foliar nutrient practices

same finding that foliar application of nutrient helps in spreading of root system and gives more site for rhizobia infection, and increase their proliferation in rhizospere, helps in forming more effective nodules and their dry weight.

Effect on yield attributes and yields of urdbean

The effect of foliar application of nutrients on yield attributes and yield was found significant. Maximum number of pod per plant (66.4), pod length (4.6 cm), number of grains per pod (7.3), 1000-grain weight (41.9 g) and grain yield per plant (8.4) were recorded with T_{12} (foliar application of 2% Urea + 2 % SSP + 0.1 % Zinc EDTA + 0.2 % Borax) whereas lowest number of pod per plant (32.4), pod length (2.9 cm), number of grains per pod (4.8), 1000-grain weight (24.6 g) and grain yield per plant (4.6) were noticed in control (water spray). More number of pods per plant under these treatments might be due to the more number of branches, dry matter accumulation per plant. Foliar application treatments made the availability of nutrients rapidly and easy and plant took all the nutrients for accelerating various physiological processes, which ultimately improved the plant growth and number of pod per plant, number of grain per pods and 1000 seed weight (Khanda *et al*., 1999).

1000-grain weight is the index of boldness of grains resulting from transfer of photosynthates from vegetative phase to reproductive phase. Less inter plant competition in above treatments might have resulted in bolder seeds as compared to that of the others. The foliar application of the combination of nutrients improved the source sink relationship triggering and increased in the number of pods per plant. The results confirmed the findings of Kokubun (2011) and Vivek Kumar Singhal *et al*. (2015) at Bikaner, Rajasthan. The results also confirmed the findings of Girish T. Limbikai *et al*. (2015).

Highest Urdbean grain yield (2280 kg ha^{-1}) was recorded in treatment T_{12} (2% Urea + 2 % SSP + 0.1 % Zinc EDTA + 0.2 % Borax whereas lowest yield (1472 kg ha^{-1}) was noticed in control (water spray). Straw yield also recorded highest in case of T_{12} (2% Urea + 2 % SSP + 0.1 % Zinc EDTA + 0.2 % Borax) and the lowest in case of control (water spray). The results confirmed the findings of Jyothi *et al*. (2013) at Hyderabad. The results also confirmed the findings of Gowthami and Rao (2014) at Hyderabad and Yanni (1992) at Kanpur.

Protein content in grains and protein yield

The highest protein content (23.3%) was recorded in T_{12} (2% Urea + 2 % SSP + 0.1 % Zinc EDTA + 0.2 % B (Borax) followed by T_2 (2% Urea). Whereas, the lowest protein content (21.9%) was observed in control (water spray). Bellaloui *et al*. (2010) from Geoderma confirmed the above finding. The highest protein yield (531.8 kg ha^{-1}) was found in T_{12} (2% Urea + 2 % SSP + 0.1 % Zinc EDTA + 0.2 % B (Borax) treatment which was significantly higher than that of the remaining treatment except T_{11} (2% Urea + 0.1 % Zinc EDTA + 0.2 % B (Borax), T_9 (2% Urea + 2 % SSP + 0.1 % Zinc EDTA) and T_7 (2% Urea + 0.1 % Zinc EDTA) which did not differ significantly. While, the lowest protein yield (322 kg ha^{-1}) was noticed in control (water spray). Protein yield is a function of protein content in grain and grain yield per hectare. Higher the grain yield, higher the protein yield. Higher accumulation of photosynthates and nitrogen uptake was obtained during the crop growth stage in T_{12} and T_{11} which proved the way for higher protein yields. Pandey and Gupta (2012) confirmed the above results.

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