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Influence of phosphorus fertilization and thiourea on productivity and economics of *kharif* urdbean [*Vigna mungo* L.] under North Gujarat agro-climatic zone

KM Bhedarada, MR Faldu and MG Chaudhary

Abstract
An experiment was conducted during *kharif* 2019 at Agronomy Instructional Farm, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, to study the "Response of urdbean (*Vigna mungo* L.) to phosphorus fertilization and thiourea". Fifteen treatment combinations comprising three levels of phosphorus and five sprays of thiourea were evaluated in randomized block design with factorial concept with three replications. Significantly higher values of growth parameters viz., plant height at 60 DAS and at harvest, number of branches per plant, leaf area index and yield attributes viz., number of pods per plant, length of pod, number of seed per pod along with seed yield and stover yield were recorded with application of 60 kg P_2O_5/ha and thiourea 1000 ppm spray at branching and flowering which was at par with 40 kg P_2O_5/ha and thiourea 500 ppm spray at branching and flowering.

Keywords: Phosphorus, thiourea, urdbean, productivity

Introduction
Urdbean (*Vigna mungo* L.) is third important pulse crops of India and Gujarat state in particular. It is grown throughout the country during both in summer and rainy seasons. Urdbean contributes about 13 per cent of total area and 10 per cent production of pulses in our country. It is grown on 5.43 m ha area with a production of 3.56 mt and productivity of 655 kg/ha in the country (Anonymous, 2017-18) [1]. This crop is extensively grown in the states of Maharashtra, Andhra Pradesh, Uttar Pradesh, Madhya Pradesh, Tamil Nadu, Rajasthan and Gujarat. In Gujarat, it is mainly grown in Vadodara, Patan, Mehsana, Dahod, Sabarkantha, Banaskantha and Valsad districts. Despite of being such an important pulse crop, the average productivity of crop in the state is quite lower than its production potential.
Phosphorus is second most critical plant nutrient, but for pulses, it assumes primary importance, owing to its important role in root proliferation and thereby atmospheric nitrogen fixation. The phosphorus deficiency is usually the most responsible factor for poor nodulation and low yield of leguminous crops including urdbean in all type of soils. Apart from its essential role in growth and development of roots and root nodules which provide habitation for rhizobium bacteria, phosphorus has been reported well for better growth, yield, quality and enormous nodule formation in legumes (Sammauria *et al*. 2009) [8].
Thiourea contains 42.1 percent sulphur and 36.8 percent nitrogen. Use of thiourea, recognized as plant growth regulator as (Sahu and Solanki, 1991) [7]. Thiourea may also enhance phloem loading of sucrose and hence translocation of photosynthets. The exogenous supply of growth regulators also modifies plant growth by hormonal control, differentiation, morphogenesis and key physiological processes such as carbon and nutrient assimilation, partitioning of photosynthates and utilization efficiency. Soaking of seeds and foliar spray of thiourea have been reported not only to improve growth and development of plants, but also the dry matter partitioning for increased grain yield (Arora, 2004) [2]. Therefore, the present investigation was planned to find out the response of urdbean (*Vigna mungo* L.) to phosphorus fertilization and thiourea.

Materials and Methods
An experiment was conducted during *kharif* 2019 at Agronomy Instructional Farm, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. The soil of experimental field was loamy sand in texture, low in organic

carbon (0.29 %) and available nitrogen (137.56 kg/ha), medium in available phosphorus (43.42 kg/ha), low in available sulphur (9.22 ppm) with soil pH of 7.56.

Fifteen treatment combinations comprising three levels of phosphorus (20, 40 and 60 kg P_2O_5/ha) and five sprays of thiourea (TU_0: Water spray at branching and flowering, TU_1: Thiourea 500 ppm spray at branching, TU_2: Thiourea 500 ppm spray at branching and flowering, TU_3: Thiourea 1000 ppm spray at branching and TU_4: Thiourea 1000 ppm spray at branching and flowering) were evaluated in randomized block design with factorial concept with three replications. Urdbean variety Gujarat Urd 1 (GU 1) was sown with spacing of 30 cm by using seed rate of 15 kg/ha on 13th July, 2019. Whole amount of phosphorus through di-ammonium phosphate was drilled 8- 10 cm deep in soil at the time of sowing as per treatments. Foliar spray of thiourea was done 500 ppm and 1000 ppm solution at branching and flowering stages as per treatment. The growth and yield attributes were recorded from the five tagged plants in each plot. Seed and stover yield were recorded from the net plot area and converted into kilogram per hectare base.

In order to evaluate most effective and remunerative treatment, relative economics of each treatment was calculated. The gross realization in terms of rupees per hectare was worked out for each treatment taking in to consideration the prevailing market price of the produce. Likewise, the cost of cultivation starting from preparatory tillage to harvest of the crop including threshing and cleaning as well as cost of inputs viz., seeds, fertilizers, irrigations etc. were also workout. The cost of cultivation was deducted from the gross realization to work out net realization for each treatment and recorded accordingly. The benefit:cost ratio (B:C) was calculated by dividing gross return with cost of cultivation.

The data has been subjected to statistical analysis by adopting analysis of variance as described by Cochran and Cox (1957) [3]. Wherever, the 'F' values found significant at 5 per cent level of probability, the Critical Difference (C.D.) values had been computed for making comparison among the treatment means.

Result and Discussion

Effect of phosphorus

The data outlined in Table 1 indicated that growth attributes *viz*., plant height at 60 DAS (46.97 cm) and at harvest (52.91 cm), number of branches per plant (6.63) and as depicted in Table 2 yield attributes *viz*., number of pods per plant (17.20), length of pod (5.66 cm), number of seeds per pod (5.61), seed yield (1199 kg/ha) and stover yield (2325 kg/ha) recorded significantly higher values with application of phosphorus @ 60 kg P_2O_5/ha (P_3) but it was at par with treatment P_2 (40 kg P_2O_5/ha). This might be explained with the fact that phosphorus deficiency also limits biological N fixation mainly by reducing the growth of host plant. Thus, artificial application of phosphorus through inorganic fertilizers might have resulted in increased carbohydrate accumulation and their remobilization to reproductive parts of the plant, being the closest sink and hence, resulted in increased flowering, fruiting and seed formation. These results are in similarity with findings of Kumawat *et al*. (2013) [5] and Patel *et al*. (2013) [6].

There was considerable increase in net return and B:C ratio due to phosphorus application. A perusal of data presented in Table 3 revealed that the highest gross realization (₹ 72852/ha) and net realization (₹ 46101/ha) was incurred under the treatment P_3 (60 kg P_2O_5/ha). The next better treatment in view of gross realization (₹ 71733/ha) and net realization (₹ 45964/ha) was P_2 (40 kg P_2O_5/ha) with the highest benefit: cost ratio (2.78) and in case of benefit: cost ratio it was followed by treatment P_3 (60 kg P_2O_5/ha) with benefit: cost ratio value 2.72. This could be attributed to higher seed and stover yield in the treatment P_3 (60 kg P_2O_5/ha). Total cost of treatment was increased due to higher cost of fertilizers so, benefit: cost ratio was higher under treatment P_2 (40 kg P_2O_5/ha). These results are well supported with those reported by Singh *et al*. (2017) [9].

Table 1: Growth attributes of urdbean as influenced by different levels of phosphorus and thiourea sprays

Treatments	Plant height (cm) at		Leaf area index	Number of branches per plant
	60 DAS	Harvest		
Phosphorus (P)				
P_1: 20 kg P_2O_5/ha	42.39	47.12	3.70	5.33
P_2: 40 kg P_2O_5/ha	46.82	51.93	4.00	6.32
P_3: 60 kg P_2O_5/ha	46.97	52.91	4.06	6.63
S. Em. ±	1.10	1.35	0.11	0.16
C. D. (P=0.05)	3.20	3.92	NS	0.45
Thiourea (TU)				
TU_0: Water spray at branching and flowering	40.13	42.76	3.16	5.41
TU_1: Thiourea 500 ppm spray at branching	43.49	49.33	3.24	5.53
TU_2: Thiourea 500 ppm spray at branching and flowering	49.23	55.34	4.60	6.70
TU_3: Thiourea 1000 ppm spray at branching	44.25	49.88	4.13	5.98
TU_4: Thiourea 1000 ppm spray at branching and flowering	49.88	55.96	4.46	6.84
S. Em ±	1.42	1.75	0.15	0.20
C. D. (P=0.05)	4.13	5.06	0.43	0.58
C.V %	9.41	10.34	11.30	9.85

Effect of thiourea

The results presented in Table 1 revealed that growth attributes *viz.*, plant height of urdbean at 60 DAS (49.88 cm) and at harvest (55.96 cm), number of branches per plant (6.84), leaf area index (4.60) and as shown in Table 2 yield attributes *viz*., number of pods per plant (17.68), length of pod (5.86 cm), number of seeds per pod (5.81), seed yield (1274 kg/ha) and stover yield (2470 kg/ha) were significantly influenced due to thiourea sprays. It might be due to thiourea has been reported to stimulate dark fixation of CO_2 in embryonic axes (Hernandez-Nistel *et al*. 1983) [4] which has resulted into improved photosynthetic efficiency and other

physiological processes. This might be due to better absorption of nutrients applied through foliage lead to proper root and shoot growth, increase in leaf area, dry matter production and uptake of nutrients, which in turn increased dry weight of plant.

Table 2: Yield attributes of urdbean as influenced by different levels of phosphorus and thiourea sprays

Treatments	Number of pods per plant	Length of pod (cm)	Number of seeds per pod	Seed yield (kg/ha)	Stover yield (kg/ha)
Phosphorus (P)					
P_1: 20 kg P_2O_5/ha	15.91	4.69	5.07	1060	2047
P_2: 40 kg P_2O_5/ha	17.07	5.38	5.49	1181	2284
P_3: 60 kg P_2O_5/ha	17.20	5.66	5.61	1199	2325
S. Em. ±	0.36	0.12	0.13	24.40	61.29
C. D. (P=0.05)	1.04	0.36	0.37	70.67	177.55
Thiourea (TU)					
TU_0: Water spray at branching and flowering	15.69	4.70	5.08	962	1847
TU_1: Thiourea 500 ppm spray at branching	16.19	4.70	5.15	1118	2166
TU_2: Thiourea 500 ppm spray at branching and flowering	17.61	5.73	5.58	1254	2432
TU_3: Thiourea 1000 ppm spray at branching	16.47	5.22	5.35	1126	2179
TU_4: Thiourea 1000 ppm spray at branching and flowering	17.68	5.86	5.81	1274	2470
S. Em ±	0.46	0.16	0.17	31.49	79.13
C. D. (P=0.05)	1.34	0.46	0.48	91.23	229.22
C.V %	8.30	9.14	9.28	8.24	10.70

Table 3: Effect of different levels of phosphorus and thiourea sprays on economics of urdbean

Treatments	Gross realization (₹/ha)	Cost of cultivation (₹/ha)	Net realization (₹/ha)	BCR
Phosphorus				
P_1: 20 kg P_2O_5/ha	64362	24830	39532	2.59
P_2: 40 kg P_2O_5/ha	71733	25769	45964	2.78
P_3: 60 kg P_2O_5/ha	72852	26751	46101	2.72
Thiourea				
TU_0: Water spray at branching and flowering	58371	24141	34230	2.42
TU_1: Thiourea 500 ppm spray at branching	67910	23985	43925	2.83
TU_2: Thiourea 500 ppm spray at branching and flowering	76183	24898	51285	3.06
TU_3: Thiourea 1000 ppm spray at branching	68387	24371	44016	2.81
TU_4: Thiourea 1000 ppm spray at branching and flowering	77393	25641	51752	3.02

The partitioning of dry matter in plants depends on its distribution between leaves, stem and sink. Decreased flower drop due to prolonged assimilatory activity of leaves might be another possible reason for improved yield and yield attributing characters. The beneficial role of thiourea sulphydryl compound in improving the translocation of photosynthates for yield formation has been also noted in pot study under laboratory condition at BARC, Mumbai which concluded that the efficiency of transport of labelled sucrose (14-C) from stem to pod of mustard was increased by 35.1-44.1 with foliar spray treatments as compared to unsprayed control. (Srivastava *et al*. 2008) [10].

It is evident from the data presented in Table 3 that the highest gross realization (₹ 77393/ha) and net realization (₹ 51752/ha) was incurred with the treatment TU_4 (Thiourea 1000 ppm spray at branching and flowering). The next better treatment in view of gross realization (₹ 76183/ha) and net realization (₹ 51285/ha) was TU_2 (Thiourea 500 ppm spray at branching and flowering) with the highest benefit: cost ratio (3.06) and it was followed by treatment TU_4 (Thiourea 1000 ppm spray at branching and flowering) in case of benefit: cost ratio (3.02).

Conclusion

Based on the results of one year experimentation, it is concluded that for securing higher yield and net realization, urdbean should be fertilized with 40 kg P_2O_5/ha and foliar spray of thiourea @ 500 ppm at branching and flowering.

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