World Journal of Agricultural Sciences 2 (2): 185-187, 2006
ISSN 1817-3047

Improved Productivity of Mung Bean by Application of Thiourea under Arid Conditions

Nishi Mathur, Joginder Singh, Sachendra Bohra, Avinash Bohra and Anil Vyas

Microbial Biotechnology and Biofertilizer Laboratory,
Department of Botany, J.N.V. University, Jodhpur, India - 342003

Abstract: Effects of seed treatment of thiourea (500 ppm) followed by foliar application (1000 ppm) at the pre flowering stage were studied on two genotypes of mung bean (IC 39358 and IC 39535) at the farmer's field at Pal village during kharif season of 2005-06. In another experiment conducted at research field of the university campus, influence of thiourea application (seed treatment + foliar application) as above was studied on leaf metabolism and photosynthetic rate. Results revealed favourable effects of thiourea application on seed yield and dry matter production in the mung bean. In mung bean seed yield increased over control by 15.3% in cv. IC 39535 and by 24.0% in cv. IC 39358 by thiourea application. This was associated with beneficial effects on total dry matter production, pod number, pod weight and seed weight per plant in this legume. Thiourea application also showed favourable effects on net photosynthesis and levels of leaf metabolites viz. total chlorophyll, starch, reducing sugars and soluble protein as well as nitrate reductase activity. It has been concluded that application of thiourea as pre- sowing seed treatment (500 ppm) followed by a single foliar spray (1000 ppm) at pre-flowering stage significantly improved plant growth and seed yield of mung bean due to enhanced photosynthetic efficiency and efficient leaf metabolism.

Key words: Mung bean · leaf metabolism · photosynthesis · thiourea application · yield

INTRODUCTION

Mung bean is important arid legume crop, which is predominant in arid and semi-arid tracts of Indian sub continent under rainfed condition because of their higher drought tolerance [1]. Growth and yield of legume is, however, limited due to low and erratic precipitation leading to frequent droughts. Thiourea -a sulf hydral compound (NH_2-CS-NH_2) known for breaking dormancy and stimulating germination [2] has also been reported to significantly improve growth, yield and water use efficiency of wheat [3], pearl millet [4] moth bean [5] under arid and semi-arid conditions both of Western Rajasthan. Recently Burman *et al.* [6] reported that application of thiourea either alone or in combination with phosphorus significantly enhanced net photosynthesis, leaf area, chlorophyll content and nitrogen metabolism of mung bean, leading to improvement in seed yield under water stress condition. In view of the promising effect of thiourea, the present investigation was undertaken to assess the performance of mung bean with thiourea application at the field level. In addition, the effects of thiourea were also explored on leaf metabolism and net photosynthesis of these legumes at the research field of the university campus to understand various physiological processes associated with thiourea mediated growth.

MATERIALS AND METHODS

Two sets of experiments were undertaken during kharif 2005 season to study the effects of thiourea application on mung bean, one at farmer's field, Adam Khan (Pal, Jodhpur Distt.) and another research field at University campus, Jodhpur.

In the experiment conducted at field level, the effect of pre socking seed treatment of thiourea (500 ppm) followed by one foliar spray (1000 ppm) at the pre flowering stage was studied on the performance of two genotypes of mung bean (IC 39358 and IC 39535). Each genotype was grown in field area both under control (no application of thiourea) and thiourea application (seed treatment + foliar spray). The soil of the experimental sight was sandy soil in texture, having pH 7.6, organic carbon 0.35%, total nitrogen 0.028%, available P_2O_5 16 kg h^{-1} and available K_2O 245 kg h^{-1}. the legume sown on July under rainfed condition. Mung bean genotype is harvest in the last week of October as per their maturity duration.

Corresponding Author: Dr. Anil Vyas, Microbial Biotechnology and Biofertilizer Laboratory, Department of Botany, J.N.V. University, Jodhpur, India - 342003

Before harvest of each mung bean genotype, 5 representative plots of 3 x 3 m^2 were randomly selected for recording data on yield attribute, seed yields and total dry matter production under each treatment in the legume (crop plant).

The second experiment was undertaken at the research field of university campus where effect of thiourea seed treated (500 ppm) + one foliar spray (1000 ppm) at the pre-flowering stage was studied on the leaf metabolism, net photosynthesis and performance of mung bean (IC 39358) sowing was done on last week of July due to last onset of the rains and the crop faces only 174 mm precipitation during the crop period. Ten days after the foliar application of thiourea, samples from two upper most fully expanded leaves from control and thiourea treated plants were analyze, in triplicate, for the contain of total chlorophyll [7], starch [8], reducing sugars [9], soluble protein [10] and nitrate reductase activities [11]. At the same time, net photosynthetic rate was measured in upper most fully expanded leaves using LICOR 6200 potable photosynthetic system. Data on seed yield and dry matter production (DMP) were recorded at harvest separately from various treatments.

RESULTS

Data recorded on seed yield and above ground dry matter production from farmer field (Pal village) revealed that thiourea application significantly increased seed yield of legume in each genotype as compared to their respective controls (Table 1). In mung bean, seed yield due to thiourea application increased by 15.3% in genotype IC 39535 and by 24.0% in genotype IC 39358. However, genotype IC 39358 yield better than genotype IC 39535 under both the treatments. Above ground biomass significantly increased by thiourea application. The increase in DMP varied from 13.5 to 44.8% in mung bean (Table 1).

Results of the second experiment conducted at the research field, university campus field also showed favorable effects of thiourea application on leaf metabolism of mung bean. Thiourea treated plants, displayed higher contents of total chlorophyll, starch, reducing sugars, soluble protein besides higher activity of nitrate reductase (NR) (Table 2) compared to untreated controls- The NR activity showed more than 18.0% increased in mung bean plants. Soluble protein concentration also increased about 15% in mung bean by thiourea application. These results indicate that thiourea favorably affects nitrogen metabolism in the legume. Such beneficial effects of thiourea have also been reported earlier in clusterbean plants under water limited conditions [5, 6]. In mung bean total DMP increased from 650 (control) to 725 kg ha^{-1} (11.4% increase) and the increase in seed yield was 13.7%.

DISCUSSION

There was a favorable influence of thiourea application in the mung bean. It is noteworthy that improvement in growth and seed yield was also associated with a significant increase in yield attributes by application of thiourea. For instance pod number, pod weight and seed weight per plant significantly increased by thiourea in both the genotypes of crop. These results confirm earlier reports on the thiourea

Table 1: Influence of thiourea on yield and yield attributes of mung bean genotypes

Genotypes	Treatment	Seed yield (ha^{-1})	DMP shoot (ha^{-1})	Seed weight (ha^{-1})	Pod weight (ha^{-1})	Pod number per plant
IC 39535	Control	420-405	1315	3.68-3.70	7.50-7.20	17.0
	Thiourea	482-467	1501	4.25-4.27	8.53-8.23	19.4
IC 39538	Control	438-432	1400	3.98-4.02	8.45-9.45	21.0
	Thiourea	543-537	2017	4.94-4.98	11.28-12.28	28.5
LSD (0.05)	-	28	93	0.31	0.65	2.5

Table 2: Influence of thiourea on net photosynthetic rate, leaf metabolites and nitrate reductase activity of mung bean

			(mg g^{-1} dw)				
Legumes	Treatments	Net photosynthesis (μ mol $m^{-2}s^{-1}$)	Total chlorophyll	Starch	Reducing sugars	Soluble protein	Nitrate reductase activity (μ g NO_2 dw h^{-1})
IC 39535	Control	8.34±0.35	4.98±0.17	116.8±4.4	15.20±0.70	36.15±1.42	352.6±14.2
	Thiourea	9.50±0.32	5.18±0.18	157.0±4.3	16.61±0.72	41.57±1.21	416.1±12.1
IC 39358	Control	8.49±0.39	5.02±0.18	120.8±4.5	15.80±0.70	40.25±1.46	382.6±12.2
	Thiourea	9.65±0.36	5.22±0.19	161.0±4.4	17.21±0.77	45.67±1.25	446.1±10.1

mediated significant improvement of seed yield of wheat [3], pearl millet [4], clusterbean [5], moth bean [12] and mung bean [13] under arid and semi-arid conditions. It is further obvious from the present study that beneficial effects of thiourea are reproducible and feasible at the farmer's fields also. Furthermore, the photosynthetic efficiency of thiourea applied plants was also better as net photosynthetic rate in the mung bean was markedly higher along with the higher contents of total chlorophyll and starch compared to control. Thiourea is reported to delay leaf ageing and senescence and enhance photosynthetic efficiency leading to increased growth and yield of plants [3, 5, 14]. This contention has been supported by the results of the present study. Thus, thiourea application favourly affects, both carbohydrate and nitrogen metabolism which in turn enhances plant performance. It was observed that application of thiourea increased dry matter production and seed yield in mung bean though the biomass and yield as such were low due to severe terminal drought experienced by the crops.

The results of both these experiments indicate that application of thiourea as pre-sowing seed treatment followed by a single foliar spray at pre-flowering stage significantly improved the growth and seed yield of mung bean at the farmer's fields also. The positive effects of thiourea seemed to be mediated through enhanced photosynthetic efficiency besides more efficient carbohydrate and nitrogen metabolism.

REFERENCES

1. Garg, B.K., 2003. Physiological aspects of abiotic stress tolerance in arid legumes. In: Advances in Arid Legumes Research (Eds. A. Henry, D. Kumar and N.B. Singh). Scientific Publishers, Jodhpur, pp: 347-354.
2. Polyakoff-Mayber, A. and A.M. Mayer, 1960. Effect of thiourea on germination and growth. Indian J. Plant Physiol., 3: 125-138.
3. Sahu, M.P. and D. Singh, 1995. Role of thiourea in improving productivity of wheat (*Triticum aestivum* L.). Journal of Plant Growth Regulation. 14:169-173.
4. Parihar, G.N., M.P. Sahu and N.L. Joshi, 1998. Nitrogen, sulphur and thiourea nutrition of pearl millet [*Pennisetum glaucum* (L.) R. Dr.] II. Effect on yield and yield components. Annals of Arid Zone, 37: 59-67.
5. Garg, B.K., U. Burman and S. Kathju, 2003. Influence of thiourea on photosynthesis, nitrogen metabolism and yield of clusterbean under moisture deficit condition. In: 2nd Intl. Congress of Plant Physiology, IARI, New Delhi, pp: 158.
6. Burman, U., B.K. Garg and S. Kathju, 2004. Interactive effects of thiourea and phosphorus under simulated water stress. Biologia Plantarum, 48: 61-65.
7. Arnon, D.I., 1949. Copper enzymes in isolated chloroplasts. Polyphenol oxidase in *Beta vulgaris*. Plant Physiology, 24: 1-15.
8. Yemm, E.W. and A.J. Willis, 1954. The estimation of carbohydrates in plant extracts by anthrone. Biochemical J., 37: 508-514.
9. Nelson, N., 1944. A photometric adaptation of the Somogyi method for the determination of glucose. J. Biol. Chem., 153: 375-380.
10. Lowry, O.H., N.Z. Rosenborough, A. L and R.J. Randall, 1951. Protein measurement with Folin-phenol reagent. J. Biol. Chem., 93: 265-272.
11. Jaworski, E., 1971. Nitrate reductase assay in intact plant tissue. Biochemical Biophysical Research Communication, 43: 1274-1279.
12. Singh, I., M.S. Rathore, M.S. Chundawat and I. Singh, 2003. Effect of thiourea on dew bean grown in low fertile undulating soil of the Thar Desert. In: Advances in Arid Legumes Research (Eds. A. Henry, D. Kumar and N.B. Singh). Scientific Publishers, Jodhpur, pp: 233-235.
13. Singh, S., M.S. Rathore and S. Singh, 2003. Influence of phosphorus and thiourea on yield and economics of green gram (*Vigna radiata*). Research on Crops, 4: 210-212.
14. Sahu, M.P., N.S. Solanki and N. Dashora, 1993. Effects of thiourea, thiamine and ascorbic acid on growth and yield of maize (*Zea mays* L.). J. Agron. & Crop Sci., 171: 65-69.