Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2020; 9(1): 906-910
Received: 28-11-2019
Accepted: 30-12-2019

Sarita
Ph.D. Research Scholar, Department of Agronomy, COA, Mandor, AU, Jodhpur, Rajasthan, India

Sharma OP
Emeritus Professor, Department of Agronomy, SKNAU, Jobner, Rajasthan, India

Ishwar Singh
Professor, Department of Agronomy, COA, Mandor, AU, Jodhpur, Rajasthan, India

Shukla UN
Assistant Professor, Department of Agronomy, COA, Mandor, AU, Jodhpur, Rajasthan, India

Saroj Kumari Yadav
Ph.D. Research Scholar, Department of Agronomy, RARI, SKNAU, Jobner, Rajasthan, India

Corresponding Author:
Sarita
Ph.D. Research Scholar, Department of Agronomy, COA, Mandor, AU, Jodhpur, Rajasthan, India

Productivity and economics of mungbean [*Vigna radiata* (L.)] as influenced by fertility levels and stress mitigating chemicals

Sarita, Sharma OP, Ishwar Singh, Shukla UN and Saroj Kumari Yadav

Abstract

An experiment was conducted during *Kharif* season of 2017 on loamy sand soil to study the Enhancing productivity and profitability of mungbean [*Vigna radiata* (L.)] by application of fertility levels and stress mitigating chemicals. Results from the study indicated that the application of 75% RDF being at par with 100% RDF, significantly increased the plant height and dry matter accumulation plant-^{1}, number of branches plant-^{1}, chlorophyll content, seed (1077 kg ha-^{1}), straw (2279 kg ha-^{1}) and biological yield (3356 kg ha-^{1}) net returns (₹ 45295 ha-^{1}), B:C ratio (2.79) over preceding levels over control (₹ 26774 ha-^{1}) and 50% RDF (₹ 37566 ha-^{1}). Among foliar spray application of thiourea significantly increased the plant height, dry matter accumulation plant-^{1}, number of branches plant-^{1}, chlorophyll content seed (1048 kg ha-^{1}), stover (2276 kg ha-^{1}) and biological yield (3324 kg ha-^{1}), net returns (₹ 44185 ha-^{1}) and B:C (2.77) ratio over SA and control but remained at par with SA + 2% urea (₹ 41605 ha-^{1} and 2.66).

Keywords: Thiourea, flower initiation, mungbean, fertility levels

Introduction

India has become self sufficient with regard to production of cereals but still lags behind with respect to the production of pulses. However, during last decades, pulse production has remained stagnant around 14 to 16 mt. Mungbean occupies third rank after chickpea and pigeonpea among pulses. It occupies 4.26 million hectares area and contributes 2.01 mt in pulse production in the country (DES, Ministry of Agriculture & FW (DAC&FW), GoI, 2017-18). In Rajasthan, total area under mungbean was 22.4 lakh hap with the production of 9.71 lakh tonnes and productivity of 473 kg ha^{-1} (Anonymous, 2017-18). Mungbean [*Vigna radiata* (L.) Wilczek] is a self pollinated leguminous crop which is grown during *kharif* as well as summer season in arid and semi arid regions. Being a short duration crop, mungbean fits well in various multiple and intercropping systems. The major part of nitrogen is met through *Rhizobium* present in the root nodules of Mungbean. Hence, crop requires starter dose of additional nitrogen for its initial growth and development. In terms of significance, phosphorus is the most indispensable mineral nutrient for legume crops as it helps in better root growth and development. Phosphorus is an essential constituent of nucleic acid (RNA and DNA), ADP and ATP, nucleoproteins, amino acid, protein, several co-enzymes (NADP), *viz.*, thiamine and pyrodoxyl phosphate.

Thiourea is an important sulphydral compound which contains one –SH group and is known to bring marked biological activity in plants. Its beneficial effect appears to be due to delayed senescence of both vegetative and reproductive organs as thiourea has cytokinin like activity, particularly delaying senescence (Halmann, 1980) [8]. Salicylic acid is involved in endogenous signalling to trigger plant defense against pathogens. This positive effect of SA could be attributed to an increased CO_2 assimilation, photosynthetic rate and increased mineral uptake by the stressed plant under SA treatment. Hence, application of stress mitigating chemicals might prove beneficial in crop tolerance to adverse conditions. The only way to combat this problem is by application of agro-chemicals especially thiourea and salicylic acid which have great promise as evidenced by the earlier work reported in this regard.

Material and Methods

Climate and weather

The climate of this region is a typically semi-arid, characterized by extremes of temperature during both summer and winter. The average annual rainfall of this tract varies from 250 mm to 300 mm and is mostly received during the months of July to September. During summer, temperature may go as high as 46 ^{0}C while in winter, it may fall as low as -1.5 ^{0}C.

There is hardly any rain during winter and summer. During crop season witnessed a rainfall of 147 mm. The mean daily maximum and minimum temperatures during the growing season of mungbean fluctuated between 29.4 to 36.6 ^{0}C and 18.4 to 26.6 ^{0}C, respectively. Similarly, mean daily relative humidity ranged between 37 to 81 per cent.

Experimental site

An experiment was conducted at Agronomy farm, S.K.N. College of Agriculture, Jobner in Jaipur district of Rajasthan during *Kharif* season of 2017 on loamy sand soil. Geographically, Jobner is situated 45 km west of Jaipur at 26^{0} 05' North latitude, 75^{0} 28' East longitude and at an altitude of 427 meters above mean sea level.

Experimental detail and treatment

The experiment consisted of four fertility levels control (F_0), 50% RDF (F_1), 75% RDF (F_2), 100% RDF (F_3) and stress mitigating chemicals control (S_0), SA @ 75 ppm at flower initiation and 7 days after first spray (S_1), 75 ppm SA + 2% Urea at flower initiation (S_2) and 500 ppm Thiourea (S_3). The total 16 treatment combinations were tested in factorial randomized block design with three replications; plot size was 4 m x 3.6 m for crop; seed rate is 20 kg ha-1. mungbean was sown on 6th July 2017. Fertilizers were applied as per treatment through diammonium phosphate (DAP) containing 46% P_2O_5 and 18% N and urea containing 46% N at the time of sowing as per treatment. Thiourea and salicylic acid treatments were administered as foliar spray with 500 lit water per hactare. Foliar spray of thiourea @ 500 ppm applied as 500 mg liter^{-1} and salicylic acid 75 ppm as 75mg liter^{-1} was done at flower initiation and salicylic acid + 2% urea at flower initiation and salicylic acid 75 ppm 7 days after first spray.

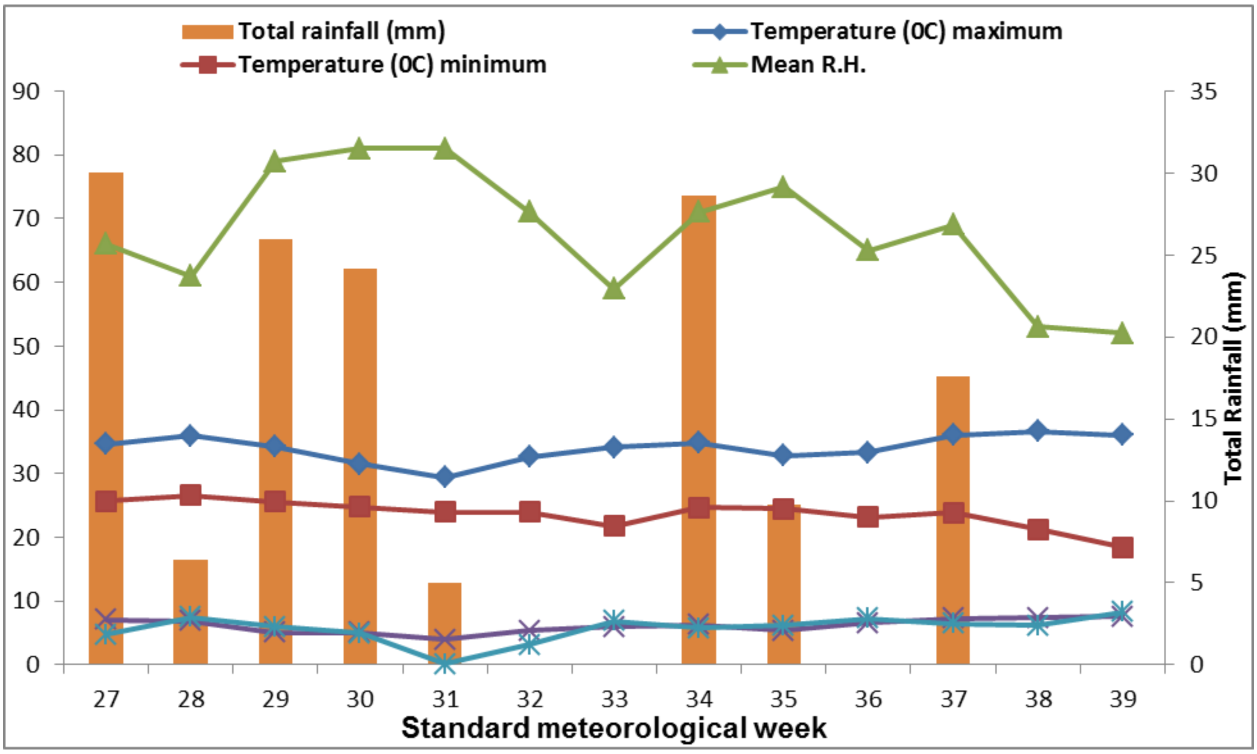

Fig 1: Mean weekly weather parameters recorded during crop season (*kharif*, 2017)

Results and Discussions

Effect of fertilizer levels

Application of 75% RDF increased the plant height by 20.01 and 9.92 per cent at 25 DAS, 16.82 and 7.45 per cent at 50 DAS and 16.52 and 7.61% at harvest over control and 50% RDF, respectively but remained at par with 100% RDF. Hence, 75% RDF remained the most effective treatment. Data (Table 1) revealed that number of branches of mungbean were significantly influenced due to fertility levels at both the stages wherein 75% RDF produced significantly higher number of branches over 50% RDF and control with the per cent magnitude of 7.31 and 26.61 at 50 DAS and 7.48 and 29.10 at harvest, respectively. Further application of fertilizer up to 100% RDF could not influence the branching significantly. Dry matter accumulation in general increased with the advancement of crop stage. Data (Table 1) indicated that there was significant difference among the fertility levels with respect to their ability to accumulate dry matter at all the stages. Increasing fertility levels up to 75% RDF significantly improved the dry matter accumulation over its preceding levels at all the stages by percent increase of 18.66 and 43.54 at 25 DAS, 6.87 and 22.52 at 50 DAS and 10.43 and 20.93 at harvest, respectively compared to 50% RDF and no fertilizer treatment. Data (Table 1 indicated that graded levels of fertilizer application to mungbean significantly increased the total chlorophyll content in plant leaves up to 75% RDF. The increase in chlorophyll content due to 75% RDF was 18.36 and 7.40% over control and 50% RDF, respectively. Further application of fertilizer up to 100% RDF could not bring about significant variation in chlorophyll content. The results indicated that application of fertility levels up to 75% RDF recorded significantly higher seed, stover and biological yield of mungbean over preceding fertility levels but remained at par with 100% RDF (Table 1). Application of varying fertility levels at 50, 75 and 100% RDF enhanced the harvest index over control by 7.73, 12.76 and 14.55%, respectively and remained at par amongst them. Similarly, the application of fertilizer upto 75% RDF brought about significantly higher net returns (₹ 45295 ha^{-1}) and B:C ratio (2.79) over the lower levels. Further increase in fertility level at 100% RDF failed to bring significant increase in net returns and B:C ratio. Both nutrients are plays key role in mungbean seed formation and are responsible for keeping the system operating smoothly of mungbean plants, overall an increase in seed, straw, biological yield of mungbean. (Meena and Yadav, 2015) [14]. In general, NPK were responsible for increased plant height, nodulation pattern, growth and yield parameters or ultimately yields and quality of mungbean. The present results are also in agreement with the findings on legume crops work has been done by several workers (Awomi *et al*., 2012, Meena *et al*., 2015b) [5, 15].

Effect of stress mitigating chemicals

A perusal of data (Table 1) further revealed that stress mitigating chemicals brought about significant variation in plant height over control at 25, 50 DAS and at harvest. Foliar spray of thiourea (S_3) being at par with SA+ 2% Urea (S_2) significantly increased plant height over control (S_0) and sole application of SA (S_1) with the % increase of 19.10 and 10.28 at 25 DAS, 16.13 and 7.80 at 50 DAS and 18.51 and 9.68 at harvest, respectively. Further, foliar spray of SA + 2% Urea and SA alone, both being statistically equal, increased the plant height over control by 13.52 and 8.00% at 25 DAS, 11.88 and 7.72% at 50 DAS and 12.46 and 8.05 at harvest, respectively. It is clear from data (Table 1) that difference in number of branches plant $^{-1}$was found significant due to foliar spray of agro-chemicals over control. However, spray of thiourea produced significantly more number of branches plant^{-1} over rest of the treatments but remained at par with SA + 2% Urea (S_2). The magnitude of increase due to thiourea and SA + 2% Urea in comparison to control was 27.40 and 21.75% at 50 DAS and 29.47 and 21.76 at harvest, respectively. Application of SA+ 2% Urea being at par with SA, increased the number of branches over control by 21.75 and 16.10% at 50 DAS and 21.76 and 14.04% at harvest. SA alone also proved superior to control at both the stages. Foliar spray of chemicals significantly increased the dry matter accumulation plant^{-1} over control at all the successive stages. Application of thiourea (S_3) remaining at par with SA + 2% (S_2) Urea enhanced the dry matter accumulation appreciably over control and SA with the per cent increase of 47.50 and 12.50 at 25 DAS, 20.73 and 10.47 at 50 DAS and 16.80 and 8.94 at harvest, respectively. Further examination of data showed that SA alone being at par with SA+ 2% Urea also increased the dry matter accumulation over control by 31.14% at 25 DAS, 9.28% at 50 DAS and 7.21% at harvest, respectively. Data (Table 1) also showed that spray of 500 ppm thiourea recorded the maximum chlorophyll content (4.23 mg g^{-1}) in fresh leaves of mungbean. It was closely followed by application of SA + 2% Urea (4.00 mg/g) which was significantly higher by 0.45 and 0.81 mg g^{-1} over 75 ppm SA and control, respectively. The foliar application of thiourea @ 500 significantly recorded the grain, stover and biological yield, net returns (₹ 11618 ha^{-1}), B:C ratio (2.77) of mungbean by over control and remained at par with SA @ 75 ppm + 2% Urea at over rest of the treatments (Table 2). The beneficial role of thiols (Thiourea and SA+ 2% Urea), sulphydryl compounds in improving the translocation of photosynthates for yield formation. Thiourea as bio-regulator has potential for increasing crop productivity under environmental stresses, which are mainly high temperature and drought due of changing climate and global warming. These beneficial effect of thiourea and SA +2% Urea on the seed yield and yield attributes in crops has also been reported by several research workers (Ali and Mahmoud, 2013, Kumawat *et al.*, 2014, Matwa *et. al.*, 2017) [1, 9, 13].

Correlation studies

To study the relationship of growth parameters and yield, simple correlation was worked out between seed yield and dry matter accumulation, straw yield, biological yield (Table 3). Correlation coefficient study revealed that the yield was significantly and positively correlated with dry matter accumulation, straw yield, biological yield. The corresponding values for correlation coefficients were 0.979, 0.992 and 0.997, respectively.

Table 1: Effect of fertility levels and Stress mitigating chemicals on growth parameters and yield of mungbean

Treatments	Plant stand			Plant height (cm)		Number of branches plant^{-1}		Dry matter accumulation (g plant-^{1})			Chlorophyll content (mg g^{-1})	Seed Yield (kg/ha)	Straw Yield (kg/ha)	Biological Yield (kg/ha)
	20 DAS	At harvest	25 DAS	50 DAS	At harvest	50 DAS	At harvest	25 DAS	50 DAS	At harvest				
Fertility levels														
F_0- Control	10.59	10.17	15.69	34.54	49.39	6.95	7.01	0.62	4.44	9.22	3.43	743	1867	2610
F_1-50%RDF	10.84	10.57	17.13	37.55	53.48	8.20	8.42	0.75	5.09	10.43	3.78	940	2125	3065
F_2-75% RDF	10.94	10.78	18.83	40.35	57.55	8.80	9.05	0.89	5.44	11.15	4.06	1077	2279	3356
F_3-100% RDF	11.24	10.98	19.38	41.52	58.26	9.00	9.30	0.91	5.62	11.53	4.16	1133	2341	3474
SEm±	0.26	0.26	0.39	0.87	1.32	0.20	0.20	0.02	0.11	0.23	0.08	23	40	63
CD (P = 0.05)	NS	NS	1.13	2.51	3.80	0.57	0.58	0.05	0.32	0.67	0.24	68	114	183
Stress mitigating chemicals														
S_0 - Control	10.60	10.30	16.12	35.33	49.81	7.08	7.26	0.61	4.63	9.70	3.42	858	1971	2829
S_1- SA @ 75 ppm at flower initiation and 7 days after first spray	10.80	10.60	17.41	38.06	53.82	8.22	8.28	0.80	5.06	10.40	3.78	979	2162	3141
S_2 - SA @ 75 ppm + 2% Urea at flower initiation	11.00	10.70	18.30	39.53	56.02	8.62	8.84	0.85	5.31	10.90	4.00	1008	2203	3211
S_3 - Thiourea @ 500 ppm at flowering initiation	11.20	10.90	19.20	41.03	59.03	9.02	9.40	0.90	5.59	11.33	4.23	1048	2276	3324
SEm±	0.26	0.26	0.39	0.87	1.32	0.20	0.20	0.02	0.11	0.23	0.08	23	40	63
CD (P = 0.05)	NS	NS	1.13	2.51	3.80	0.57	0.58	0.05	0.32	0.67	0.24	68	114	183
CV (%)	8.41	8.37	7.64	7.82	8.34	8.33	8.19	8.38	7.51	7.62	7.59	8.01	7.02	7.01

Table 2: Effect of fertility levels and stress mitigating chemicals on net returns and B:C ratio

Treatments	Net returns ₹/ha	B : C ratio
Fertility levels		
F_0 - Control	26774	2.14
F_1 - 50% RDF	37566	2.52
F_2 - 75% RDF	45295	2.79
F_3 - 100% RDF	48113	2.86
SEm±	1059	0.07
CD (P = 0.05)	3059	0.19
Stress mitigating chemicals		
S_0 - Control	32567	2.32
S_1- SA @ 75 ppm at flower initiation and 7 days after first spray	39391	2.55
S_2 - SA @ 75 ppm + 2% Urea at flower initiation	41605	2.66
S_3 - Thiourea @ 500 ppm at flowering initiation	44185	2.77
SEm±	1059	0.07
CD (P = 0.05)	3059	0.19
CV (%)	9.01	8.86

Table 3: Correlation coefficients showing relationship between seed yield and independent variables (X)

Dependent variable (Y)	Independent variables (X)	Correlation coefficient (r)
Seed yield	Dry matter accumulation	0.979**
	Straw yield	0.992**
	Biological yield	0.997**

Conclusion
It may be concluded that Fertilizing the crop with 75% RDF brought about significantly higher seed yield (1077 kg/ha), net returns (₹ 45295/ha) and B:C ratio (2.79). Foliar application of either 500 ppm thiourea or 75 ppm SA + 2% urea at flower initiation is recommended to obtain significantly higher seed yield (1048 and 1008 kg/ha), net returns (₹ 44185 and ₹ 41605/ha).

References

1. Ali EA, Mahmoud AM. Effect of foliar spray by different salicylic acid and zinc concentrations on seed yield and yield components of mungbean in sandy soil. Asian Journal of Crop Science. 2013; 5:33-40.
2. Anonymous. Posted Economics, Generic Crop India II PR English Production and Productivity, Pulse Development Scheme, ZPD Kanpur, 2016.
3. Arnon DI. Copper enzymes in isolated chloroplasts I polyphenol oxidase in Beta Vulgaris. Plant Physiology. 1949; 21:1-15.
4. Arora D. Effect of thiourea and zinc on growth, yield and quality of barley (*Hordeum vulgare* L.) Ph.D. Thesis, Rajasthan Agricultural University, Bikaner, 2004.
5. Awomi TA, Singh AK, Kumar M, Bordoloi LJ. Effect of phosphorus, molybdenum and cobalt nutrition on yield and quality of mungbean (*Vigna radiate* L.) in acidic soil of Northeast India. Indian Journal of Hill Farmarming. 2012; 25:22-26.
6. Fisher RA. Statistical Methods for Research Workers. Oliver and boyd, Edinburg, London, 1950, 57-63p.
7. Gopalan G, Ramasastri BV, Balasubramanian SC. Nutritive value of Indian foods. ICMR, Hyderabad-5000, India, 1995.
8. Halmann M. Synthetic plant growth regulators. Advances in Agronomy. 1980; 43:47-105.
9. Kumawat K, Shivran AC, kumawat P. Effect of bioregulators and phosphorus on yield, economics, nutrient uptake and quality of mothbean [*Vigna aconitifolia* (jacq.) Marechal]. Annals of Biology. 2014; 30:98-101.
10. Kuttimani R, Velayutham A. Foliar application of nutrients and growth regulators on yield and economics of greengram. Madras Agricultural Journal. 2011; 98:141-143.
11. Singh M, Singh RK, Hardev ANR, Prasad SR. Growth, yield attributes and quality of summer green gram (*Vigna radiata* L.) as influenced by nitrogen and irrigation levels. Annals of Agricultural Research New Series. 2014; 35:47-53.
12. Mathur N, Singh J, Bohra S, Bohra A, Vyas A. Improved productivity of mungbean [*Vigna radiata* (L.) Wilczek] by application of thiourea under arid condition. World Journal of Agriculture Science. 2006; 2:185-187.
13. Matwa D, Rao KP, Dhewa JS, Rajveer. Effect of Plant Growth Regulators (PGRs) and Micronutrients on Flowering and Yield Parameters of Green gram (*Vigna radiata* L.). International Journal of Current Microbiology and Applied Sciences. 2017; 6:2350-2356.
14. Meena, RS, Yadav RS. Yield and Profitability of Groundnut (*Arachis hypogaea* L) As Influenced by Sowing Dates and Nutrient Levels with different varieties. Legume Research. 2015; 38:791-797.
15. Meena RS, Yadav RS, Meena H, Kumar S, Meena YK, Singh A. Towards the current need to enhance legume productivity and soil sustainability worldwide. A book review. Journal of Cleaner Production. 2015b; 104:513-515.
16. Meena RS, Yadav RS, Meena VS. Heat unit efficiency of groundnut varieties in scattered planting with various fertility levels. The Bio scan. 2013; 9:1189-1192.
17. Metson AI. Method of chemical analysis for survey samples. Bulletin No. 2 Department Science. Mediterranean Research Soil Bureau, 1956, 12.
18. Olsen SR, Cole CV, Watanable FS, Dean LA. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. Circular, United States Department of Agriculture, 1954, 932p.
19. Richards LA. Diagnosis and Improvement of Saline and Alkaline Soils, USDA Hand Book no. 60, Oxford and IBH Pub. Co., New Delhi, 1954.

20. Sahu MP, Solanki NS, Dashora LN. Effect of thiourea and ascorbic acid on growth and yield of maize (*Zea mays* L.). Journal of Agronomy and Crop Science. 1993; 171:65-90.
21. Singh BR. Effect of thiourea and molybdenum on productivity of moth bean [*Vigna aconitifolia* (Jacq.) Marechal.]. M.Sc. (Ag.) Thesis, Rajasthan Agricultural University, Bikaner, 2007.
22. Subbiah BV, Asija GI. A rapid procedure for the estimation of available nitrogen in soils. Current Science. 1956; 25:259-260.
23. Walkley, Black IA. Estimation of soil organic carbon by the chromic acid titration method. Soil Sciences. 1947; 37:29-38.