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Effect of fertility levels and stress mitigating chemicals on yield attributes and yield of mungbean (*Vigna radiata* (L.) Wilczek)

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Abstract
A field experiment was conducted to analyse the effect of fertility levels and stress mitigating chemicals on yield attributes and yield of mungbean at Agronomy farm, S.K.N. College of Agriculture, Jobner, Jaipur (Raj) during *kharif* season of 2017. The experiment was laid out in factorial randomized block design (FRBD) and consisted of sixteen treatments combination had equal levels of fertility levels and stress mitigating chemicals *i.e.* four levels. Among fertility levels, significantly higher number of pods plant^{-1} (20.51), seeds pod^{-1} (8.32), test weight (33.50 g), seed yield (1133 kg ha^{-1}), stover yield (2341 kg ha^{-1}) and biological yield (3474 kg ha^{-1}) were recorded under 100% RDF and showed significant superiority over the rest of the treatments while treatment had received 75% RDF (F_3) in context to yield attributes and yield showed at par results. Among stress mitigating chemicals application of thiourea @ 500 ppm at flower initiation recorded significantly higher number of pods plant-1 (20.00) and seeds pod^{-1} (8.18), test weight (32.16 g) seed yield (1048 kg ha^{-1}), stover yield (2276 kg ha^{-1}) and biological yield (3324 kg ha^{-1})over rest of treatments, but at par with SA @ 75 ppm + 2% Urea.

Keywords: Fertility levels, mungbean, seed yield, SA (Salicylic acid), Thiourea

Introduction

Mungbean [*Vigna radiata* (L.) Wilczek] is a self-pollinated leguminous crop which is mostly grown during *kharif* in arid and semi-arid regions. However, some parts of India it can also be grown in summer season. It is tolerant to drought and can be grown successfully on well drained loamy to sandy loam soils even in the areas of erratic rainfall. It is an excellent source of protein (24.5%) with high quality lysine (460 mg g^{-1} N) and tryptophan (60 mg g^{-1} N) containing, 51% carbohydrate and 3% vitamins (Gopalan *et al*., 1995) [5]. It occupies 4.26 million hectares area and contributes 2.01 million tonnes in pulse production in the country (Anonymous, 2016) [2]

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. Phosphorus is the most indispensable mineral nutrient for legume crops as it helps in better root growth and development and thereby making them more efficient in biological nitrogen fixation (BNF) and indirectly it is also reduced the effect of drought. 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. The nitrogen fixation is more at the time of flowering, hence, phosphorus provides energy in the form of ATPs to the plant system.

The dry spell frequently observed during *kharif* season due to erratic nature of rainfall particularly in Rajasthan and mungbean being a short duration crop is heavily affected. Therefore, stress mitigating chemical like salicylic acid and thiourea are played important role in escaping drought in mungbean (Ali and Mahmoud, 2013) [1]. 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) [6]. Foliar spray of thiourea has been reported not only to improve growth and development of plants, but also the dry matter partitioning for increased grain yield (Arora, 2004) [3]. It promotes growth in cytokinin requiring callus tissues in absence of kinetin in various crops. Salicylic acid (SA) is a naturally occurring plant hormone acting as an important signalling molecule which adds to tolerance against abiotic stresses.

It plays a vital role in plant growth, ion uptake and transport. Salicylic acid is involved in endogenous signalling to trigger plant defence 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. Plants respond to environmental stresses by synthesis of signalling molecules. These signalling molecules activate a range of signal transduction pathways, some of which relieve the plant to overcome stress. SA is reported to act as a defence signal as has been well established in many plants and has qualified as a plant hormone due to its physiological roles and has been suggested as a signal transducer or messenger under stress conditions. Application of these stress mitigating chemicals in conjunction with fertilizer doses might be provide a best management practice in order to understand the proven technology. Since, under such situation, the crop response to fertilizer application varies due to deficit moisture or uncertain weather conditions.

Materials 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 has been observed during winter and summer. During crop season, remarkable rainfall of 147 mm was received. 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 was ranged between 37 to 81%.

Experimental site and treatment

An experiment was conducted at Agronomy farm, S.K.N. College of Agriculture, Jobner, Jaipur (Rajasthan) during *kharif* season of 2017. Geographically, Jobner is situated 45 km west of Jaipur at 26^0 05' North latitude and 75^0 28' East longitudes with altitude of 427 meters. The area falls in agro-climatic zone-IIIa *i.e.* semi-arid eastern plain zone of Rajasthan. The soil of the experimental field was loamy-sand in texture, alkaline in reaction (P^H 8.2), poor in organic carbon (0.18%), low in available nitrogen (128.3 kg ha^{-1}) and medium in phosphorus (16.23 kg ha^{-1}) and potassium (154.26 kg ha^{-1}). The experiment consisted of four fertility levels *viz*. 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). Total sixteen treatment combinations were tested in factorial randomized block design and replicated thrice. The plot size was 4.0 m x 3.6. The crop was sown on 6thJuly 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. Thiourea and salicylic acid were applied as per treatments by administered as foliar spray dissolving it inrequired amount of water to obtained proper concentrations.

Results and Discussions

Yield attributes

Effect of fertilizer levels

The various fertility levels significantly affect the yield attributes and yield. It was evidences from the data as the fertility level increases, the yield attributes and yield had increased (Table 1). The significantly higher no. of pods plant^{-1} (20.51), no. of seeds pods-^{1} (8.32) and test weight (33.50 g) were recorded under 100% RDF (F_3) and showed superiority over rest of the treatments except 75% RDF where it was at par with each other with respect to no. of pods plant^{-1} (20.30), no. of seeds pods^{-1} (8.28) and test weight (32.60 g). The right amount of phosphorus can help crops yield more pods and create healthier stocks and root systems (Meena *et al*., 2015b) [14]. the increased supply of NPK and their higher uptake by plants might have stimulated the rate of various physiological processes in plant and led to increased yield parameters and ultimately resulted in increased seed and straw yields. These similar results were also reported by Manoj *et al*. (2014) [14].

Effect of stress mitigating chemicals

The mungbean is very prone to dry spell occasionally observed in *kharif* season due to discontinuous rainfall. In this context, stress mitigating chemical would have greater importance in maintain cellular integrity and stability under stress conditions (Table 1). The data conspicuously revealed that foliar application of thiourea @ 500 ppm significantly increased no. of pods plant^{-1} (20.0), no. of seeds pods^{-1} (8.18) and test weight (32.16 g) and showed significantly superiority over control while it was at par with treatments received two sequential spray of salicylic acid @ 75 ppm at flower initiation and 7 days after first spray (S_1) and salicylic acid @ 75 ppm + 2% Urea at flower initiation (S_2). Foliar spray of agro-chemicals resulted in stimulatory action in various physiological processes of plant. The beneficial effect of thiourea and SA +2% Urea on the yield attributes in crops has also been reported by several research workers (Mathur *et al.*, 2006 and Ali and Mahmoud, 2013) [10, 1]

Yield

Effect of fertilizer levels

The yield is the resultant of genotypes and environmental interaction and influenced greatly by different levels of fertility (Table 2). The data indicated that application fertilizers at recommended dose i.e. 100% RDF (F_3) had significant effect on seed yield (1133 kg ha^{-1}), straw yield (2341 kg ha^{-1}) and biological yield (3474 kg ha^{-1}) and found significantly better over other fertility levels, while it was at par with 75% RDF. The treatments had received 75% RDF also recorded significantly higher seed yield (1077 kg ha^{-1}), stover yield (2279 kg ha^{-1}) and biological yield (3356 kg ha^{-1}) and showed superiority over 50% RDF level and control. 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. Meena and Yadav (2015) [12] reported that nutrients are played 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. 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) [4, 14].

Effect of stress mitigating chemicals

The scanning of data revealed that foliar application of stress mitigating chemicals *i.e.* thiourea @ 500 ppm significantly recorded higher seed yield (1048 kg ha^{-1}), stover yield (2276 kg ha^{-1}) and biological yield (3324 kg ha^{-1}) and showed significant superiority over rest of the treatments, but at par with two sequential application of salicylic acid @ 75 ppm at flower initiation and 7 days after first spray (S_1) with respect to straw yield. However, thiourea @ 500 ppm was remained at par with salicylic acid @ 75 ppm + 2% Urea at flower initiation (S_2) (Table 2). There was at par result obtained for harvest index among treatments. This was might be due to beneficial effect of thiourea and salicylic acid which improved translocation of photosynthates to seeds results in higher seed yield. Also thiourea act as bio-regulator that has potential to stabilized yield under higher temperature and moisture stress condition. The findings are also in conformity with findings of Ali and Mahmoud (2013) [1], Kumawat *et al.*, (2014) [7] and Matwa *et al.* (2017) [11].

Correlation studies

To validate the relationship of yield attributes with yield, simple correlation was worked out between seed yield and number of pods per plant, number of seeds pod^{-1}, test weight, straw yield, and biological yield (Table 3). Correlation coefficient study revealed that the yield was significantly and positively correlated with number of pods plant^{-1}, number of seeds pod^{-1}, test weight, stover yield and biological yield, The corresponding values for correlation coefficients were 0.983 0.942, 0.994, 0.992 and 0.997,respectively.

Table 1: Effect of fertility levels and stress mitigating chemicals on yield attributing characters of mungbean

Treatments	No. of pods plant^{-1}	No. of Seeds pod^{-1}	Test weight (g)
Fertility levels			
F_0 - Control	16.13	6.16	26.60
F_1 - 50% RDF	19.14	7.27	30.15
F_2 - 75% RDF	20.30	8.28	32.60
F_3 - 100% RDF	20.51	8.32	33.50
S.Em+	0.39	0.16	0.64
CD (P = 0.05)	1.14	0.45	1.85
Stress mitigating chemicals			
S_0- Control	17.45	6.10	28.35
S_1- Salicylic acid @ 75 ppm at flower initiation and 7 days after first spray	19.12	7.70	30.55
S_2- Salicylic acid @ 75 ppm + 2% Urea at flower initiation	19.51	8.04	31.80
S_3-Thiourea @ 500 ppm at flowering initiation	20.00	8.18	32.16
S.Em+	0.39	0.16	0.64
CD (P = 0.05)	1.14	0.45	1.85
CV (%)	7.17	7.23	7.24

Table 2: Effect of fertility levels and stress mitigating chemicals on seed, stover and biological yields and harvest index in mungbean

Treatments	Yield (kg ha^{-1})			Harvest index (%)
	Seed	Stover	Biological	
Fertility levels				
F_0 - Control	743	1867	2610	28.44
F_1 - 50% RDF	940	2125	3065	30.64
F_2 - 75% RDF	1077	2279	3356	32.07
F_3 - 100% RDF	1133	2341	3474	32.58
S.Em+	23	40	63	0.74
CD (P = 0.05)	68	114	183	2.14
Stress mitigating chemicals				
S_0 - Control	858	1971	2829	30.16
S_1- Salicylic acid @ 75 ppm at flower initiation and 7 days after first spray	979	2162	3141	31.00
S_2 - Salicylic acid @ 75 ppm + 2% Urea at flower initiation	1008	2203	3211	31.22
S_3 - Thiourea @ 500 ppm at flowering initiation	1048	2276	3324	31.36
S.Em+	23	40	63	0.74
CD (P = 0.05)	68	114	183	NS
CV (%)	8.01	7.02	7.01	8.29

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

Dependent variable (Y)	Independent variables (X)	Correlation coefficient (r)
Seed yield	No. of pods plant^{-1}	0.983**
	No. of seeds pod^{-1}	0.942**
	Test weight	0.994**
	Straw yield	0.992**
	Biological yield	0.997**

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(1):33-40.
2. Anonymous, Posted Economics, Generic Crop India II PR English Production and Productivity, Pulse Development Scheme, ZPD Kanpur, 2016.
3. 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.
4. Awomi TA, Singh AK, Kumar M, Bordoloi LJ. Effect of phosphorus, molybdenum and cobalt nutrition on yield and quality of mungbean (*Vigna radiata* L.) in acidic soil of Northeast India. Indian Journal of Hill Farmarming. 2012; 25(2):22-26.
5. Gopalan G, Ramasastri BV, Balasubramanian SC. Nutritive value of Indian foods. ICMR, Hyderabad-5000, India, 1995.
6. Halmann M. Synthetic plant growth regulators. Advances in Agronomy. 1980; 43:47-105.
7. 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(1):98-101.
8. Kuttimani R, Velayutham A. Foliar application of nutrients and growth regulators on yield and economics of greengram. Madras Agricultural Journal. 2011; 98(4):141-143.
9. Manoj, Singh RK, Singh, AN, Hardev R, 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(1):47-53.
10. 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(2):185-187.
11. 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(4):2350-2356.
12. 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(6):791-797.
13. Meena RS, Yadav RS, Meena VS. Heat unit efficiency of groundnut varieties in scattered planting with various fertility levels. The Bioscan. 2013; 9(1):1189-1192.
14. 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.
15. 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.
16. 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.