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Research Article

Effect of Stress Mitigating Chemicals on Productivity of Clusterbean [*Cyamopsis tetragonoloba* (L.) Taub] Varieties

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ABSTRACT

A field experiment was conducted on the experimental field of S. K. N. College of Agriculture, Jobner, to evaluate the effect of different stress mitigating chemicals on the productivity of clusterbean [Cyamopsis tetragonoloba (L.) Taub] varieties. The treatments consisted of combinations of four varieties (RGC-1003, RGC-1033, RGC-1038 and RGC-1055) and five stress mitigating chemicals (Control, Thiourea, Thioglucolic acid, Salicylic acid and Muriate of Potash). These were tested in Randomised Block Design (RBD) with three replications. Results revealed the highest N, P and K uptake (98.49, 10.89 and 46.15 kg/ha), Seed yield (1469 kg/ha), Biological yield (4735 kg/ha), stover yield (3266 kg/ha), net returns (Rs. 42204) and B:C ratio (2.80) were recorded in variety 'RGC- 1033' and it proved best and economically profitable as compared to other varieties. Application of 500 ppm thiourea at branching and flowering stage significantly increased the quality of seed and stover, seed yield and stover yield (1369 and 3106 kg/ha) and proved economically beneficial compared to over control. However, spray of thioglycolic acid @ 100 ppm at branching and flowering recorded at par net returns with foliar application of thiourea @ 500 ppm.

Keywords: *Clusterbean, Varieties, Foliar spray, Thiourea, MOP, Salicylic acid, Thioglycolic acid, Stress mitigating chemicals.*

INTRODUCTION

Clusterbean [*Cyamopsis tetragonoloba* (L.) Taub] is an important legume crop of *Kharif* season in arid and semi-arid regions of tropical India. It is considered one of the most drought-tolerant grain legumes grown on sandy soils of arid and semi-arid regions. In India, this crop is mostly grown in the dry habitats of Rajasthan, Haryana, Gujarat and Punjab and to a limited extent in U.P. and M.P. In Rajasthan, clusterbean is mainly grown in Barmer, Churu, Sriganganagar, Nagaur, Jalore, Sikar, Jaisalmer, Bikaner, Jaipur and Alwar districts. In India, clusterbean is grown on 5.6 million hectares with an annual production of 2.7 million tonnes and productivity of 485 kg/ha (Anonymous, 2013-14).

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The maximum contribution in respect of area is shared by Rajasthan (4.9 m ha) with the annual production of 2.2 million tonnes and productivity of 447 kg/ha (Anonymous, 2016-17). The crop survives best even at moderate levels of soil salinity and alkalinity. The use of stress mitigating chemicals has been stated to modify various metabolic processes to regulate plant growth. Several researchers working on different crops have reported that the use of growth substances/ regulators is one of the effective means for delaying senescence of leaves and retarding abscission of reproductive organs. Application of growth regulators increases flower, fruit setting, grain filling and test weight of different crops.

Among stress mitigating chemicals, thiourea plays a vital role in physiological processes of plants and modifying the growth, yield and quality of clusterbean crops. Thiourea is a sulphahydral compound containing one –SH group (Jocelyn, 1972). It is easily available and cost-wise cheaper than others. The –SH group has been implicated in photosynthate translocation in crop plants (Giaquinta, 1976).

MATERIALS AND METHODS

The experiment was conducted at Agronomy farm, S.K.N. College of Agriculture, Jobner, during *Kharif* season of 2017. The area falls in agro-climatic zone-IIIA (Semi-arid eastern plain zone) of Rajasthan. The soil was loamy sand in texture, the alkaline in nature (P^H – 8.2), poor in organic carbon content (0.17%) with low available nitrogen (128.5 kg/ha) and medium potassium content (18.30 kg/ha), respectively. Rainfall received during the period of June to October was 382 mm. The twenty treatment combinations consist of four varieties (RGC-1003, RGC-1033, RGC-1038 and RGC-1055) and five stress mitigating chemicals (Control, Thiourea, Thioglucolic acid, Salicylic acid and Muriate of Potash) were tested in Randomised Block Design with three replications. Seeds were sown manually, maintaining a spacing of 30 cm X 10 cm, with 20 kg/ ha seed rate. Each plot consisted of a gross size of 3.0 m X 4.0 m and a net size of 1.8m X 2.0 m. Phosphorus as per treatments was applied as basal dose. In order to all three operations *VIZ.*, thinning, hoeing and weeding were done 20 DAS to maintain the recommended spacing, proper aeration and weed-free field. Net returns and benefit: cost ratio were evaluated by using the prevailing market prices for clusterbean varieties. Growth parameters like Leaf Area Index, Leaf Area Duration, Crop Growth Rate and Relative Growth Rate were worked out by using standard methods of analysis and formulas:

Growth indices

3.8.1.8 Leaf Area Index ($\overline{LAI}$)

Five plants were selected for measurement of leaf area at 60 DAS and 90 DAS. Leaf area was measured with a portable leaf area meter at the experimental site. LAI was calculated by the following relationship (Watson, 1958).

$$\text{Leaf Area Index} = \text{Leaf Area (cm}^2\text{)} / \text{ Ground Area (cm}^2\text{)}$$

3.8.1.9 Leaf Area Duration ($\overline{LAD}$)

Leaf area duration is the integral of the leaf area index over a growth period (Watson, 1952). LAD for various growth periods was worked out as per the formula of Power et al. (1967) and expressed in days.

$$\overline{LAD} = (L_1 + L_2)/ 2 \times (t_2 - t_1)$$

Where,

L_1 = LAI at time t_1

L_2 = LAI at time t_2

$t_2 - t_1$ = Time interval in days.

3.8.1.10 Crop Growth Rate ($\overline{CGR}$)

CGR of a plant for a time 't' was defined as an increase in the dry weight of the plant material

from a unit area per unit of time. It was calculated with the following formula (Radford, 1967) from periodic dry matter recorded at 30DAS, 60DAS and at harvest.

$$CGR = W_2 - W_1 / t_2 - t_1$$

Where,

W_1 = Total dry weight of plant at time t_1

W_2 = Total dry weight of plant at time t_2

t_1 = Time at first observation

t_2 = Time at second observation

3.8.1.11 Relative growth rate (RGR)

The RGR of a plant at an instant in time (t) is defined as the increase in dry weight of plant material per unit of material already present per unit of time. The RGR of the crop was calculated by the following formula (Radford, 1967) and expressed in g / g / day.

$$RGR = (\log_e W_2 - \log_e W_1) / (t_2 - t_1)$$

Where,

Log_e = Natural log

W_1 and W_2 are total dry matter at time t_1 and t_2, respectively.

Nutrient content, uptake and quality parameters:

3.8.3.1 Nitrogen concentration and its uptake

The seed and straw samples were analyzed separately for nitrogen concentration (%) by the standard (Nessler's reagent) colourimetric method (Snell & Snell, 1949). The uptake of nitrogen by crop was calculated using the following formula:

N uptake (kg/ha) = [N conc. In seed % X Seed yield (kg/ha) + N conc. in straw (%) X Straw yield (kg/ha)] / 100

3.8.3.2 Phosphorus concentration and its uptake

The seed and straw samples were analyzed for phosphorus concentration by Vanadomolybdo phosphoric yellow colour method in the sulphuric acid system (Method No. 60, USDA Hand Book No. 60, & Richards, 1954). The uptake of phosphorus by crop was calculated using the following formula:

$$\text{P uptake (kg/ha)} = \frac{\text{P conc. in seed (\%)} \times \text{Seed yield (kg/ha)} + \text{P conc. in straw (\%)} \times \text{Straw yield (kg/ha)}}{100}$$

3.8.3.3 Potassium concentration and its uptake

Potassium concentration in seed and straw was estimated by the flame photometer method (Jackson, 1973). The uptake of potassium by crop was calculated using the following formula:

$$\text{K uptake (kg/ha)} = \frac{\text{K conc. in seed (\%)} \times \text{Seed yield (kg/ha)} + \text{K conc. in straw (\%)} \times \text{Straw yield (kg/ha)}}{100}$$

3.8.3.5 Protein content in grain

Protein content in grain was calculated by multiplying nitrogen concentration in grain (%) with a factor 6.25 (A. O. A. C., 1960).

RESULTS AND DISCUSSION

Growth parameters and yield attributes

Effect of varieties:

variety RGC-1055 and variety RGC-1033 being at par with each other recorded significantly taller plants than RGC-1003 and RGC-1038 (Table- 1). Variety RGC-1033 have more branching and dry matter at all the crop growth stages as compared to other varieties. The variety RGC-1033 produced significantly higher dry matter over RGC-1003, RGC-1038 and RGC-1055 at harvest by 22.3, 7.79 and 8.93 per cent, respectively. This variety also recorded higher growth indices i.e., LAI, LAD, CGR and RGR over RGC-1003, RGC-1038 and RGC-1055. RGC-1033 recorded a significantly higher leaf area index (3.09) over RGC-1003 and remained at par with RGC-1038 and RGC-1055 (Table 1). RGC-1033 recorded a significantly higher number of pods per plant (39.50) over RGC-1003 and RGC-1055. RGC-1033 being at par with RGC-1038 and RGC-1055 produced a significantly higher number of seeds per pod (8.13) over RGC-1003 (7.27) and registered an increase of 11.8 per cent. The variety RGC-1033 recorded significantly higher test weight over RGC-1003, RGC-1038 and RGC-1055 by 12.9, 6.32 and 6.20 per cent, respectively. The difference among the varieties could be explained solely by variation in their genetic make-up and their differential behaviour under different climatic conditions, Klyani and Lakshmi (2012) and Rawat et al. (2015). Kumar and Kaushik (2014) observed that clusterbean variety RGC-936 recorded significantly higher plant height and dry matter as compared to RGc-1003 and RGC-1002.

Effect of foliar application of stress mitigating chemicals:

Results indicated that application of thiourea at branching and flowering stage being at par with TGA, salicylic acid and MOP significantly increased plant height (96.4) over control at harvest. Similarly, dry matter and growth indices: LAI, LAD, CGR and RGR were significantly increased by application of thiurea @ 500 ppm at branching and flowering stage (Table 1). The number of pods per plant, the number of seeds and test weight were significantly increased by thiourea over salicylic acid, MOP and control. The overall growth of the plants was increased in terms of plant height and leaf area, which contributed to higher dry matter production.

Yield, economics and quality parameters:

Effect of varieties:

Results revealed that variety RGC-1033 significantly increased the seed, stover, and biological yield and remained at par with variety RGC-1055 over other varieties (Table 2). Thus a consequence of a marked improvement in both these regulative processes as evident from a higher accumulation of biomass and nutrients as well as yield components under variety RGC-1033 led to the significant increase in the seed yield due to its genetic potential when grown under semi-arid conditions and improved growth at successive stages Ayub et al. (2010).

Effect of stress mitigating chemicals:

Further results revealed that application of 500 ppm thiourea at branching and flowering stage significantly increased the yield attributes, yield, protein content, net returns, B:C ratio and total nutrient uptake over other stress mitigating chemicals at all stages of growth (Table 2).

It was concluded that under prevailing conditions clusterbean variety ‘RGC-1033’ appear suitable for cultivation under semi-arid Rajasthan. However, the application of 500 ppm thiourea at the branching and flowering stage could be helpful for stabilizing the yield and quality of the crop.

Table- 1 Effect of stress mitigating chemicals on growth and yield attributes of clusterbean varieties

Treatments	Plant height (cm)	Dry matter (g)	Growth parameters at 60 DAS to at harvest				Yield attributes		
			Leaf area index	Leaf area duration	Crop growth rate	Relative growth rate	N. of pods/ plant	N. of seeds/ pod	Test weight
Varieties									
RGC-1003	85.1	134.5	2.64	62.17	0.87	7.65	32.60	7.27	25.31
RGC-1033	95.1	164.6	3.09	75.69	1.11	8.56	39.47	8.13	28.59
RGC-1038	92.7	152.7	2.94	71.21	1.06	8.50	37.13	8.07	26.89
RGC-1055	101.1	151.1	2.96	71.93	1.06	8.49	35.27	7.93	26.92
SEm±	2.48	3.20	0.06	1.43	0.02	0.20	0.77	0.16	0.42
CD (P=0.05)	7.10	9.15	0.17	4.10	0.07	0.59	2.20	0.45	1.21
Stress mitigating chemicals									
Control	85.4	142.3	2.73	64.83	0.96	7.53	33.42	7.25	25.45
Thiourea (500 ppm)	96.4	158.4	3.14	77.41	1.08	8.55	39.42	8.33	28.03
Thioglycolic Acid (TGA) (100 ppm)	95.4	153.0	2.97	72.20	1.04	8.53	36.17	8.17	27.35
Salicylic Acid (100 ppm)	95.4	151.2	2.89	69.66	1.03	8.48	36.08	8.08	27.07
Muriate of Potash (2%)	94.9	148.7	2.80	67.15	1.01	8.41	35.50	7.42	26.75
SEm±	2.77	3.58	0.07	1.60	0.03	0.23	0.86	0.18	0.47
CD (P=0.05)	7.93	10.23	0.19	4.59	0.08	0.66	2.46	0.50	1.35
CV (%)	10.27	8.22	7.89	7.91	9.29	9.56	8.23	7.72	6.08

Table- 2 Effect of stress mitigating chemicals on yield, economics and nutrient uptake of clusterbean varieties

Treatments	Yield (Kg/ha)		Protein content (%)	Economics		Total nutrient uptake		
	Seed	Stover		Net returns (Rs./ ha)	B:C ratio	N	P	K
Varieties								
RGC-1003	1082	2506	25.38	25240	2.08	67.78	7.27	32.04
RGC-1033	1469	3266	27.43	42204	2.80	98.49	10.89	46.15
RGC-1038	1298	2973	25.73	34850	2.49	82.99	8.83	39.60
RGC-1055	1206	2786	25.63	30770	2.31	76.48	8.81	37.22
SEm±	30.14	65.01	0.45	1102	0.06	2.14	0.21	1.02
CD (P=0.05)	86.28	186.09	1.28	3154	0.16	6.11	0.60	2.93
Stress mitigating chemicals								
Control	1130	2605	21.69	28124	2.24	61.19	7.05	33.45
Thiourea (500 ppm)	1369	3106	30.33	37989	2.63	100.79	10.89	42.49
Thioglycolic Acid (TGA) (100 ppm)	1354	3079	27.75	35551	2.41	92.88	9.95	40.64
Salicylic Acid (100 ppm)	1301	2965	26.28	35143	2.52	82.33	9.18	39.05
Muriate of Potash (2%)	1164	2658	24.15	29525	2.30	69.98	7.69	38.15
SEm±	33.70	72.69	0.50	1232	0.06	2.39	0.24	1.14
CD (P=0.05)	96.47	208.05	1.43	3527	0.18	6.83	0.67	3.27
CV (%)	9.24	8.73	6.64	12.83	8.88	10.15	9.11	10.23

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Conflict of Interest

The author declares no conflict of interest.

Author Contribution

All authors contributed equally to establishing the research and design experiment topic.

REFERENCES

A. O. A. C. (1960). Official methods of analysis, 18th Edn. Association of Official Agricultural Chemists, Washington.

Ayub, M., Tahir, M., Nadeem, A., Zubair, M. A., Tariq, M., & Ibrahim, M. (2010). Effect of nitrogen application on growth, forage yield and quality of three clusterbean varieties. *Journal of Life and Social Sciences 8*(2), 111-116.

Jackson, M. L. (1973). *Soil Chemical Analysis*. Prentice-Hall of India Pvt. Ltd. New Delhi, pp.498.

Kalyani, D., & Lakshmi (2012). Performance of clusterbean genotypes under varied

time of sowing. *Legume Research 35*, 154.

Kumar, V., & Kaushik, V. K. (2014). Growth substances response to clusterbean [*Cyamopsis tetragonoloba* (L.)] growth parameters. *Agriculture for Sustainable Development 2*(1), 11-13.

Radford, P. J. (1967). Growth analysis formulae – their use and abuse. *Crop Science*. *7*, 171-175.

Rawat, U., Rajput, R. L., Rawat, G. S., & Garg, S. K. (2015). Effect of varieties and nutrient management on growth, yield and economics of clusterbean (Cyamopsis tetragonoloba (L.) Taub.). *Research on crops 16*(1), 64-67.

Richards, L. A. (1954). Diagnosis and improvement of saline and alkaline soils. USDA Handbook No. 60, Oxford and IBH Pub. Co. New Delhi.

Watson, D. J. (1958). The dependence of net assimilation rate on leaf area index. *Annals of Botany 22*(1), 37-54.