

Growth and Yield of Pearl millet [*Pennisetum glaucum* (L). R. Br.] as Influenced by Varieties and Bio-Regulators

Anshul Gupta, O. P. Sharma, R. B. Solanki, H. P. Verma

Received 10 June 2016; Accepted 3 July 2016; Published online 28 July 2016

Abstract A field experiment was conducted during the rainy season of 2014-15 on loamy sand soil having sixteen treatment combinations consisting of 4 treatments each of varieties (RHB-121, RHB-173, RHB-177, Raj-171) and bio-regulators (control, thiourea, thioglycolic acid and salicylic acid) were tested in randomized block design with three replications. Results indicated that pearl millet variety RHB-173 recorded significantly higher values of growth attributes viz. dry matter accumulation and total number of tillers per plant as compared to other varieties. Variety Raj-171 recorded significantly higher plant height to other varieties except RHB-173. The yield attributes (num-

ber of effective tillers per plant, ear length and number of grains per ear), grain yield and biological yield were significantly higher in RHB-173 over the remaining varieties while Raj-171 was at par in stover yield. Results further indicated that growth and yield significantly increased with application of bio-regulators over control. The application of thiourea being at par with TGA proved significantly superior over rest of the treatments. Results further indicated that growth and yield proved economically beneficial with foliar application of thiourea over other bio-regulators.

Keywords Growth, Pearl millet, Salicylic acid, Thioglycolic acid, Thiourea.

Introduction

Pearl millet [*Pennisetum glaucum* (L). R. Br.] is one of the most important *kharif* cereals of arid and semi-arid environment. Under such adverse growing conditions, selection of high yielding cultivars with appropriate maturity duration attains paramount importance. There is an urgent need to replace old varieties/hybrids with newly developed high potential cultivars for better production and profitability. Economic analysis indicates that in general, hybrid cultivation is more profitable than OPVs in arid Rajasthan. Based on the seed and stover productivity [1]. Foliar application of thiourea (TU), a novel bioregulator signifi-

A. Gupta^{1*}, O. P. Sharma², R. B. Solanki³, H. P. Verma⁴

^{1,3}MSc Agronomy, ²Professor, ⁴PhD Agronomy,
 Department of Agronomy,
 Sri Karan Narendra Agriculture University,
 Jobner 303329, Rajasthan, India
 e-mail : anshulgupta2803@gmail.com,
 radhikasolanki100@gmail.com,
 hppersoya.p@gmail.com

*Correspondence

Table 1. Growth parameters of pearl millet as influenced by varieties and bio-regulators ppm, parts per million, TGA, Thioglycolic acid.

Treatments	Plant height (cm)	Dry matter accumulation/plant (g)		Total number of tillers/plant	LAI
		60 DAS	At harvest		
Varieties					
RHB-121	148	24.80	46.50	3.65	3.82
RHB-173	157	27.13	52.50	3.93	3.83
RHB-177	148	24.60	46.18	3.40	3.80
Raj-171	162	26.42	50.00	3.38	3.90
SEm±	3.56	0.58	1.27	0.09	0.09
CD ($p=0.05$)	10.29	1.70	3.69	0.27	NS
Bio-regulators					
Control	138	22.90	42.13	3.27	3.60
Thiourea (500 ppm)	169	28.15	54.10	3.89	4.03
TGA (100 ppm)	158	26.50	50.95	3.66	3.90
Salicylic acid (100 ppm)	149	25.40	48.00	3.54	3.86
SEm ±	3.56	0.58	1.27	0.09	0.09
CD ($p=0.05$)	10.29	1.70	3.69	0.27	0.24
CV (%)	8.05	7.82	9.06	9.06	7.62

cantly improved growth and yield of several crops [2]. Further, use of thiol including thiourea (TU) and thioglycolic acid (TGA) have shown positive effect in improving growth and yield of pearl millet, wheat and mustard [3, 4]. They further reported that thiourea and bio-regulators has potential for increasing crop productivity under environmental stresses, which are now on the increase in the wake of changing climate and global warming. Salicylic acid is a naturally occurring plant hormone acting as an important signalling molecule which adds to tolerance against abiotic stresses such as drought, chilling, heavy metal toxicity, heat and osmotic stress. Therefore, keeping the above facts in view present investigation was carried out to observe the effect of different bio-regulators on pearl millet for increasing crop productivity under environmental stresses.

Materials and Methods

The experiment was conducted at the Agronomy farm, Sri Karan Narendra Agriculture University, Jobner (26°05' N, 75°28' E) in Agroclimatic zone III A (Semi-

arid Eastern Plain Zone) of Rajasthan. The soil was loamy sand in texture, alkaline in reaction (pH 8.2), poor in organic carbon (0.14%) with low available nitrogen (130 kg/ha) and medium in phosphorus and potassium content 18.9 and 175.6 kg/ha respectively. Three hybrids RHB-121, RHB-173 and RHB-177 and one composite Raj-171 of pearl millet were tested. Foliar sprays of bio-regulators viz. 500 ppm thiourea (TU), 100 ppm thioglycolic acid (TGA) and 100 ppm salicylic acid (SA) were done at 25 and 50 DAS. 1/3 dose of nitrogen was drilled as basal at the time of sowing and remaining dose of nitrogen was top dressed in 2 splits. Harvesting of pearl millet was done from each net plot when ears were dry.

Results and Discussion

Effect of varieties

The variety Raj-171 recorded the tallest plants which were significantly taller over RHB-121 and RHB-177 and remained at par with RHB-173. The increase in plant height due to Raj-171 was to the magnitude 9.37 and 9.53%, respectively over RHB-121 and RHB-177. The hybrid RHB-173 produced the significantly higher dry matter over RHB-121 and RHB-177 but remained at par with Raj-171. Variety RHB-173 surpassed all the varieties in terms of total number of tillers. However varieties could not bring significant difference in and LAI of pearl millet but application of bio-regulators increases the LAI over control (Table 1). Further, the differential behavior among the varieties could be explained solely by the variation in their genetic makeup under existing climatic conditions. Sukanya et al. [5] and Yadav et al. [6] at different locations also reported differential growth behavior of pearl millet varieties in terms of plant height and dry matter accumulation. The yield components i.e. number of effective tillers per plant, ear length and number of grains per ear were significantly higher in RHB-173 as compared to other varieties (Table 2). Further, hybrid RHB-173 produced significantly higher grain yield over RHB-121, RHB-177 and Raj-171 and higher stover yield over RHB-121 and RHB-177. Hybrid varieties recorded significantly higher harvest index over Raj-171 (Table 2). The marked increase in yield attributes under RHB-173 might be due to its genetic potential.

Table 2. Yield attributes and yield parameters as influenced by varieties and bio-regulators. ppm, Parts per million, TGA, Thioglycolic acid.

Treatments	Effective tillers/plant	Ear length (cm)	Number of grains/ear	Grain yield (kg/ha)	Stover yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)	Net returns (Rs/ha)	B:C ratio
Varieties									
RHB-121	2.45	25.86	1359	1968	4749	6718	29.35	21509	0.88
RHB0173	2.73	28.25	1480	2175	5173	7348	29.50	25951	1.06
THB-177	2.25	24.25	1254	1816	4697	6514	28.87	19535	0.80
Raj-171	2.21	22.00	1234	1724	5106	6831	25.22	20712	0.85
SEm±	0.08	0.66	37.69	53	125	177	0.88	679	0.03
CD ($p=0.05$)	0.24	1.93	109	153	361	511	2.55	1960	0.80
Bio-regulators									
Control	2.07	23.13	1216	1639	4356	5996	27.36	16066	0.66
Thiourea (500 ppm)	2.70	27.24	1445	2162	5439	7601	28.42	26959	1.09
TGA (100 ppm)	2.49	25.35	1337	2010	5082	7092	28.34	23611	0.96
Salicylic acid (100 ppm)	2.39	25.25	1328	1871	4850	6721	27.81	21071	0.87
SEm±	0.08	0.66	37.65	53	125	177	0.88	679	0.03
CD ($p=0.05$)	0.24	1.93	109	153	361	511	NS	1960	0.08
VC (%)	11.71	9.15	9.81	9.60	8.78	8.88	10.94	10.72	11.18

This variety also had longer ears with more number of grains per ear. Superior yield attributing characteristics in variety RHB-173 over RHB-121 and other varieties were also recorded in co-ordinated trials conducted as ARS Durgapura, Jaipur [7]. RHB-173 also proved most efficient in realizing highest net returns and benefit: Cost ratio, which were significantly higher over rest of the varieties.

Effect of bio-regulators

The foliar application of bio-regulators (Thiourea, TGA and SA) significantly increased the growth parameters viz., plant height, dry matter accumulation and total number of tillers per plant over control (Table 1). Application of thiourea being at par with TGA, produced the tallest plants and proved significantly superior over salicylic acid by 12.9% at harvest. Foliar spray of 500 ppm thiourea significantly increased dry matter accumulation and total number of tillers per plant over salicylic acid and control but remained at par with TGA. Thiourea has been reported to stimulate dark fixation of CO₂ in embryonic axes which has resulted into improved photosynthetic efficiency and other physiological processes [8]. Thus, these favorable influences of thiourea brought significant improvement in plant height, dry matter accumulation

and total number of tillers per plant. Foliar application of bio-regulators (Thiourea, TGA and SA) significantly increased yield attributes viz., number of effective tillers per plant, number of grains per ear and ear length over control (Table 2). The maximum grain yield, stover yield and biological yield recorded with thiourea was significantly higher over salicylic acid and control while it remained at par with TGA. Foliar spray of bio-regulators resulted in stimulatory action in various physiological processes of plant. Significant improvement in the grain yield due to foliar spray of 500 ppm thiourea was also reported by Kumar et al. [9] in pearl millet. Thiourea as bio-regulator has potential for increasing crop productivity under environmental stresses, which are now on the increase in the wake of changing climatic and global warming [4]. Salicylic acid known to be a natural molecule has been shown to play an important role in regulating various physiological processes in plants including yield. It is believed that increase in the crop yield might be due to delayed senescence of plant organs (particularly leaves and flowers) in response to exogenous SA that will automatically help the plant in extending the duration of photosynthetically active sites and also prevent premature loss of flower and fruits. Singh et al. [10] in wheat and Muhal et al. [11] in *Brassica* also observed remarkable improvement in yield at-

tributes and yields due to salicylic acid application. Foliar application of thiourea exhibited significantly highest net returns and B:C ratio among all the treatments.

Conclusion

It is concluded that variety RHB-173 out yielded over all the varieties of pearl millet and responded equally to the foliar spray of bio-regulators. Application of either 500 ppm thiourea or 100 ppm TGA sprayed at 25 and 50 DAS significantly enhanced the grain yield of pearl millet.

References

1. Sharma NK (2014) Evaluation of released varieties and hybrids of pearl millet [*Pennisetum glaucum* (L.)] for seed and stover yields in hot arid climate of Rajasthan. *Ind J Pl Genetic Resour* 27 : 63—65.
2. Garg BK, Burman U, Kathju S (2006) Influence of thiourea on photosynthesis, nitrogen metabolism and yield of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] under rainfed condition of Indian arid zone. *Pl Growth Regulation* 48 : 237—245.
3. Sahu MP, Kumawat SM, Singh G, Ramaswamy N K , D'Souza SF (2007) Consolidated progress report of the research project Establishment of Radiotracer Laboratory and Multilocation testing of crop varieties developed at BARC 2000–2007 sponsored by BRNS, Dep of Atomic Energy, Govt of India. Publ SKRAU, Bikaner (Raj.), pp 1—128.
4. Kumawat SM, Garg DK, Bhunia SR (2009) Krishi Anusandhan Ki Uplabdhiyan 2001–2008, pub, DOR, (SKNAU)/2009/02, pp 1—12.
5. Sukanya DH, ramesh CR, Hosmani SV (2004) Development of populations with improved fodder potential in pearl millet [*Pennisetum glaucum* (L.)]. *Int Sorghum and Millets Newsletter* 44 : 139—141.
6. Yadav OP, Rajpurohit BS, Kherwa GR, Kumar A (2012) Prospects of enhancing pearl millet [*Pennisetum glaucum* (L.)] productivity under drought environments of North-Western India through hybrids. *Ind J Genetics and Pl Breeding* 72 : 25—30.
7. Sharma LD, Singh Y, Sharma R (2013) All India Coordinated Research Project on pearl millet [*Pennisetum glaucum* (L.)], modification of crop varieties and registration of germplasm. *Ind J Genetics and Pl Breeding* 73 : 228—231.
8. Nistel H, Aidasoro JD, Matilla A, Nicolas G (1983) Effect of thiourea on ionic content and dark fixation of CO₂ in embryonic axes of *Cicer arietinum* seed. *Physiologia Plantarum* 57 : 273—278.
9. Kumar P, Singh F, Kumar R (2010) Studies on agro-techniques for yield maximization of pearl millet [*Pennisetum glaucum* (L.)] under rainfed conditions. *Prog Agric* 10 : 164—165.
10. Singh S, Singh H, Choudhary R (2013) Heat stress management in late sown wheat (*Triticum aestivum*) under climate change scenario. *Ann of Agric Bio Res* 18 : 135—138.
11. Muhal S, Solanki NS, Singh P, Shukla KB (2014) Effect of salicylic acid on productivity and nutrient uptake of *Brassica* species under different planting durations. *Afr J Agric Res* 13 : 1101—1106.