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Correlation studies in *Pearl millet* as influenced by varieties and bio-regulators

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Abstract
A field experiment was conducted during *kharif*, 2014 to study the effect of varieties and bio-regulators in *Pearl millet* on loamy sand soil of Rajasthan. The experiment consist of 4 *Pearl millet* varieties (RHB-121, RHB-173, RHB-177, Raj-171) and bio-regulators (control, thiourea, thioglycolic acid and salicylic acid) thereby making 16 treatment combinations tested in randomized block design with three replications. The results showed that yield attributes i.e. number of effective tillers/ plant, ear length and number of grains/ear and grain yield were significantly higher in RHB-173 over the remaining varieties while Raj-171 was at par in stover yield. Among the correlation studies the maximum correlation found between N uptake and seed yield.

Keywords: Correlation, *Pearl millet*, salicylic acid, thioglycolic acid, thiourea, varieties, yield

1. Introduction
Pearl millet [*Pennisetum glaucum* (L). R. Br.] is one of the most important millet crop of arid and semi-arid environment. It is a principal food cereal cultivated in drought prone regions of Africa and Indian subcontinent. In addition to grain and forage uses, *Pearl millet* crop residues and green plants also provide sources of animal feed, building material, and fuel for cooking, particularly in dry land areas. In Rajasthan *Pearl millet* occupies area of 3.94 m ha and annual production of 3.83 m t with productivity of 971 kg/ha (*Vital Agricultural Statistics*, 2012-13). A majority of the subsistence farmers who typically cultivate this crop are unable to take advantage of high yield potential because they have limited options for improving their management practices like unavailability of high yielding varieties, lack of knowledge, poor environmental conditions, scarcity of resources etc. Hence, *Pearl millet* production can be improved through growing varieties/hybrids with improved tolerance to drought, resistance to diseases and responding to higher rates of fertilizer applications. Sharma (2014) [8] reported that hybrid cultivation is more profitable than indigenous OPVs of *Pearl millet* in arid Rajasthan.). Foliar application bioregulators like of thiourea (TU), significantly improved growth and yield of several crops (Garg *et al*., 2006) [1]. Use of thiol including thiourea (TU) and thioglycolic acid (TGA) have shown positive effect in improving production of *Pearl millet*, wheat and mustard (Sahu *et al*., 2007 and Kumawat *et al*., 2009) [7, 3]. They further reported that thiourea and bio-regulators has potential for increasing crop productivity under harsh environmental conditions, which are now on the increase in the wake of changing climate and global warming. So this study was carried out to observe the effect of different bio-regulators on *Pearl millet* for increasing the crop production.

2. Material and methods
A field experiment was conducted during 2014 at Agronomy Farm, Department of Agronomy, Sri Karan Narendra Agriculture University, Jobner in randomized block design with three replications. The average annual rainfall of this tract varies from 300 mm to 400 mm and is mostly received in the month 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. The relative humidity fluctuated between 51 to 89 per cent. 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. The experiment consisted of four *Pearl millet* varieties (RHB-121, RHB-173, RHB-177 and Raj-171) and bio-regulators (control, 500 ppm thiourea (TU), 100 ppm thioglycolic acid (TGA) and 100 ppm salicylic acid (SA), thereby making 16 treatment combinations. Foliar spray of bio-regulators

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.

3. Results

3.1 Effect of varieties

The results (Table 1) revealed that the application variety RHB-173 recorded significantly increased number of effective tillers per plant, number of grain per ear and ear length. Further, hybrid RHB-173 produced significantly higher grain yield over RHB-121, RHB-177 and Raj-171 and higher stover yield over RHB121 and RHB-177 and hybrid varieties (RHB-173, RHB-121 and RHB-177) recorded significantly higher harvest index over Raj-171. Sharma *et al*. (2013) [9] in the co-ordinated trials conducted at ARS Durgapura, Jaipur also recorded the superior yield attributing characteristics in variety RHB-173 over RHB-121 and other varieties.

3.2 Effect of bio-regulators

The application of bio-regulators showed marked results over control. Among the bio-regulators maximum grain yield and stover yield registered with thiourea that was significantly superior over salicylic acid and control while it remained at par with TGA. 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. Application of thiourea recorded the maximum number of effective tillers/plant, ear legth and number of grain/ear and being at par with TGA proved significantly superior to SA treatment. The increase in yield attributes and yield obtained with thiourea application was most probably due to increased photosynthetic activity of crop that improved photosynthetic efficiency and source to sink relationship. Also, the increase in yield due to application of thiourea might be the result of concomitant increase in number of effective tillers per plant, length of earhead. Which is consistent with findings of Lakhana (2002) [4] and Mehta *et al*. (2009) [6] in *Pearl millet*. Significantly higher yield attributes and yield by application of SA recorded in *Pearl millet* by Mathur and Vyas (2007) [5].

4. Correlation studies

The relationship between the grain yield of *Pearl millet* and other important growth and yield attributes was studied. The data on correlation coefficient (r), coefficient of determination (R^2), regression coefficient (b) and intercept (a) are furnished in Table 2. Results revealed that plant height at harvest, dry matter accumulation at harvest, number of tillers per plant at harvest, number of effective tillers per plant, number of grain per ear, ear length, stover yield, N, P and K uptake showed positive and significant correlation with grain yield of *Pearl millet*. The correlation between grain yield and N uptake was the highest (0.964) followed by total number of tillers at harvest (0.963), effective tillers/plant (0.954), P uptake(0.937), ear length (0.935), number of grains/ear (0.892), K uptake (0.794), dry matter at harvest(0.732), stover yield (0.669), plant height at harvest (0.611), which attributed correspondingly 92.9, 92.7, 91, 87.7, 87.4, 79.5, 63, 53.5, 44.7 and 37.3 % variation in grain yield of *Pearl millet*. These findings are more or less related with reported by Govindaraj *et al.* (2009) [2].

Table 1: yield attributes and yield parameters as influenced by varieties and bio-regulators

Treatments	Effective tillers/plant	Ear length (cm)	Number of grains/ear	Grain yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
Varieties						
RHB-121	2.45	25.86	1359	1968	4749	29.35
RHB-173	2.73	28.25	1480	2175	5173	29.50
RHB-177	2.25	24.25	1254	1816	4697	28.87
Raj-171	2.21	22.60	1234	1724	5106	25.22
SEm ±	0.08	0.66	37.69	53	125	0.88
CD (P=0.05)	0.24	1.93	109	153	361	2.55
Bio-regulators						
Control	2.07	23.13	1216	1639	4356	27.36
Thiourea (500 ppm)	2.70	27.24	1445	2162	5439	28.42
TGA (100 ppm)	2.49	25.35	1337	2010	5082	28.34
Salicylic acid (100 ppm)	2.39	25.25	1328	1871	4850	27.81
SEm ±	0.08	0.66	37.65	53	125	0.88
CD (P=0.05)	0.24	1.93	109	153	361	NS
CV (%)	11.71	9.15	9.81	9.60	8.78	10.94

Table 2: Intercept (a), regression coefficient (b), correlation coefficient (r) and coefficient of determination (R2) of seed yield (dependent variable Y) with individual growth and yield attributes (independent variables Xi)

Xi	Independent variables	A	B	r	R^2
X_1	Effective tillers/plant	39.017	781.108	0.954**	0.910
X_2	Ear length (cm)	- 464.318	94.503	0.935**	0.874
X_3	Number of grains/ear	-456.386	1.785	0.892**	0.795
X_4	N uptake	389.898	26.578	0.964**	0.929
X_5	P uptake	289.404	160.46	0.937**	0.877
X_6	K uptake	-78.135	18.639	0.794**	0.630
X_7	Stover yield	78.44	0.373	0.669**	0.447
X_8	Dry matter at harvest	197.6	35.32	0.732**	0.535
X_9	Plant height at harvest	29.19	12.33	0.611**	0.373
X_{10}	Total number of tillers at harvest	-931.7	794.4	0.963**	0.927

** = Significant at 1 per cent level of significance

5. Conclusion

On the basis of one year study it may be concluded that variety RHB-173 attain highest yied over all the varieties of *Pearl millet* and application of either 500 ppm thiourea or 100 ppm TGA sprayed at 25 and 50 DAS significantly enhanced the production in *Pearl millet*

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