CSIRO PUBLISHING The South Pacific Journal of Natural Science, **27**, 45-48, 2009
www.publish.csiro.au/journals/spjns Short Communication-10.1071/SP09008

Effect of hybrids, plant density and fertility levels on nutrient concentration, uptake and productivity of pearl millet in semi arid environment

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Abstract

A Field experiment was conducted at Crop Research Farm, Chaudhary Charan Singh Haryana Agricultural University, Hisar, during the kharif seasons of 2004 and 2005 to find out suitable spacing for pearl millet hybrids along with N and P levels so as to increase the productivity of pearl millet. The experiment was laid out in split plot design allocating combinations of two hybrids and three plant densities in main plots and four fertility levels in sub plots with three replications. Highest pooled grain yield was recorded by HHB 67-2. Sowing pearl millet at 45x12 cm spacing produced highest pooled grain and stover yield. Application of 90 kg N + 45 kg P_2O_5 ha^{-1} resulted maximum pooled grain and stover yield and was at par with 60 kg N + 30 kg P_2O_5 ha^{-1}. HHB 67-2 had significantly higher total uptake over HHB 67. Wider spacing of 60x12 cm had higher NPK content but 45x12 cm resulted into higher total uptake of NPK. NPK content and uptake was found higher when pearl millet was fertilized with 90 kg N + 45 kg P_2O_5 ha^{-1}.

Key words: *Hybrids, plant density, pearl millet, NPK content and uptake***.**

1. Introduction

In India pearl millet occupies an area of 9.3 million hectare with the production and productivity of 8.1 million tones and 876 kg ha^{-1}, respectively (Economic survey, 2005-06). The productivity of pearl millet is very low in India mainly due to poor plant stand and less use of fertilizers. At the present productivity level, pearl millet removes 72 kg N, P_2O_5 and K_2O/ha/annum where as only 10-12 kg of these nutrients are being supplied through fertilizers. Therefore, there is need to improve fertility management along with optimum plant density of current hybrids for sustainable productivity of this very important crop of India.

Keeping the above points in view the field experiment was conducted to study the crop productivity, concentration and uptake behavior of nitrogen, phosphorus and potassium in pearl millet crop as influenced by hybrids, plant density and fertility levels.

2. Materials and Methods

The field experiment was conducted during *kharif* seasons of 2004 and 2005 at the Crop Research Farm, Chaudhary Charan Singh, Haryana Agricultural University, Hisar. The soil of the experimental field was sandy loam (Typic ustochrepts) and was medium in organic carbon (0.46 %), available nitrogen (191 kg ha^{-1}) and available phosphorus (14 kg ha^{-1}) and high in available potassium (340 kg ha^{-1}). The experiment was laid out in split plot design with three replications. The treatment combination of two hybrids (HHB 67 and HHB 67-2) and three plant densities 30x12 cm (277777 plants ha^{-1}), 45x12 cm (185185 plant ha^{-1}), 60x12 cm (138888 plant ha^{-1}) were randomized in main plots while four fertility levels (control, 30 kg N + 15kg P_2O_5 ha^{-1}, 60 kg N + 30 kg P_2O_5 ha^{-1}, 90 kg N + 45 kg P_2O_5 ha^{-1}) in sub plots.

The total rainfall received during the crop season was 114.9 and 424.8 mm during *kharif* 2004 and 2005, respectively. Whole of the P_2O_5 and half N as per treatments were drilled at the time of sowing and rest of the N was top dressed after thinning and gap filling (22 DAS). The breeder's seed of pearl millet hybrids as per treatment were sown on August 2, 2004 and July 20, 2005 by drilling as per plant density treatment using 5 kg seed per ha^{-1}. Recommended package of practices were followed in the crop for other agronomic operations. The crop was harvested on October 7 and September 27 during 2004 and 2005, respectively.

Nitrogen content in plants was determined by Nessler's reagent method. Phosphorus and potassium content were determined by Vanadomolybdo phosphoric acid yellow colour method and flame photometric method, respectively. The uptake was computed from the data on nitrogen, phosphorus and potassium concentration multiplied by grain/stover yield. The total uptake of N, P and K was computed by summing up the nutrient uptake by grain and stover.

3. Results and Discussion

3.1 Growth and Yield Parameters

Both hybrids did not differ significantly in plant height in both the years. The tallest plants recorded in 60 x 12 cm spacing which was statistically at par with 45 x 12 cm and better than 30 x 12 cm in both the years. Fertility levels also affected plant height significantly during both the years (Table 1). Tallest plants recorded with 90 kg N + 45 kg P_2O_5 ha^{-1} during 2004 which were statistically at par with 60 kg N + 30 kg P_2O_5 ha^{-1}. Both these treatments were significantly better than control and 30 kg N + 15 kg P_2O_5 ha^{-1} during 2004 and 2005. Both hybrids have significant variation in number of tillers $plant^{-1}$. HHB-67-2 had significantly higher tillers $plant^{-1}$ at harvest over HHB-67. Wider spacing of 60 x12 cm recorded significantly higher number of tillers and was statistically at par with 45 x 12 cm spacing during 2004 and 2005. Maximum tillers $plant^{-1}$ were achieved with 90 kg N + 45 kg P_2O_5 ha^{-1}, but it was statistically at par with 60 kg N + 30 kg P_2O_5 during 2004 and 2005. HHB 67-2 resulted significantly higher dry weight than HHB-67. Spacing of 60 x 12 cm recorded significantly higher dry matter accumulation per plant than 30 x 12 cm but at par with 45 x 12 cm spacing during both the years. Wider row spacing helped in proper utilization of natural resources i.e. moisture and nutrients but such benefits could not be realized in closer spacing due to mutual plant competition. Overall improvement in the growth of individual pearl millet plant due to wider

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spacing has also been reported by Kumar *et al.* (2004). Fertility levels significantly influenced dry matter production per plant. Application of 90 kg N + 45 kg P_2O_5 ha^{-1} resulted significantly higher dry matter accumulation than rest of the fertility treatments except 60 kg N + 30 kg P_2O_5 ha^{-1} during both the years. The overall improvement in the growth of pearl millet due to application of nitrogen and phosphorus has also been reported by Sharma and Gupta (2001).

Table 1. Effect of various treatments on plant height, tillers per plant, dry matter accumulation and yields of pearl millet.

Treatments	Plant height (cm)		Tillers/plant (Number)		Dry matter accumulation (g/plant)		Pooled Yield (q/ha)	
	2004	2005	2004	2005	2004	2005	Grain	Stover
HYBRIDS								
HHB-67	204.50	193.00	4.13	4.19	64.04	61.75	24.21	77.77
HHB-67-2	207.22	196.58	4.36	4.39	70.22	65.58	26.86	86.13
SEm ±	3.87	3.65	0.06	0.07	1.41	1.20	0.54	1.57
CD at 5%	NS	NS	0.18	0.19	4.45	3.79	1.69	4.95
SPACING (cm)								
30 X 12	194.75	184.38	4.10	4.12	61.50	58.13	23.67	78.76
45 X 12	208.83	197.13	4.26	4.33	67.40	63.75	29.20	91.52
60 X 12	214.00	202.88	4.38	4.43	72.50	69.13	23.71	75.58
SEm ±	4.73	4.47	0.07	0.10	1.73	1.48	0.66	1.92
CD at 5%	14.93	14.08	0.23	0.30	5.45	4.68	2.07	6.06
FERTILITY LEVELS								
Control	185.00	173.17	3.94	4.04	54.58	52.00	19.20	64.15
30 kg N +15 kg P_2O_5 ha^{-1}	202.33	191.33	4.25	4.28	65.07	63.17	25.19	80.91
60 kg N +30 kg P_2O_5 ha^{-1}	214.67	204.00	4.38	4.41	73.83	68.50	28.30	89.92
90 kg N +45 kg P_2O_5 ha^{-1}	221.44	210.67	4.42	4.45	75.04	71.00	29.41	92.83
SEm ±	3.32	3.60	0.06	0.08	1.23	1.06	0.48	1.26
CD at 5%	9.54	10.35	0.16	0.23	3.54	3..35	1.37	3.61

Table 2. Effect of various treatments on nutrient content of pearl millet.

Treatments	Nitrogen content (%)				Phosphorus content (%)				Potassium content (%)			
	Grain		Stover		Grain		Stover		Grain		Stover	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
HYBRIDS												
HHB-67	1.689	1.687	0.509	0.500	0.321	0.313	0.117	0.118	0.600	0.607	2.714	2.718
HHB-67-2	1.698	1.69	0.513	0.500	0.323	0.316	0.123	0.120	0.611	0.614	2.733	2.734
SEm ±	0.013	0.01	0.005	0.004	0.003	0.002	0.003	0.001	0.006	0.005	0.017	0.020
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
SPACING (cm)												
30 X 12	1.648	1.642	0.476	0.465	0.313	0.305	0.116	0.115	0.587	0.591	2.700	2.704
45 X 12	1.708	1.702	0.523	0.512	0.325	0.317	0.121	0.120	0.609	0.615	2.725	2.726
60 X 12	1.725	1.721	0.534	0.523	0.33	0.322	0.123	0.122	0.620	0.625	2.747	2.749
SEm ±	0.016	0.014	0.006	0.004	0.004	0.003	0.002	0.001	0.007	0.006	0.024	0.025
CD at 5%	0.049	0.042	0.018	0.013	0.011	0.009	0.005	0.003	0.022	0.018	NS	NS
FERTILITY LEVELS												
Control	1.62	1.615	0.457	0.447	0.293	0.286	0.105	0.105	0.548	0.555	2.627	2.630
30 kg N +15 kg P_2O_5 ha^{-1}	1.681	1.675	0.502	0.489	0.321	0.313	0.121	0.119	0.594	0.598	2.731	2.736
60 kg N +30 kg P_2O_5 ha^{-1}	1.733	1.729	0.540	0.529	0.335	0.328	0.127	0.126	0.635	0.64	2.777	2.776
90 kg N +45 kg P_2O_5 ha^{-1}	1.74	1.736	0.545	0.535	0.340	0.333	0.127	0.127	0.645	0.648	2.782	2.781
SEm ±	0.011	0.009	0.004	0.003	0.002	0.002	0.001	0.001	0.005	0.004	0.015	0.018
CD at 5%	0.032	0.028	0.013	0.01	0.007	0.006	0.002	0.002	0.016	0.012	0.044	0.052

Table 3: Effect of various treatments on nutrient uptake of pearl millet.

Treatments	Total Nitrogen uptake (kg/ha)		Total Phosphorus uptake (kg/ha)		Total Potassium uptake (kg/ha)	
	2004	2005	2004	2005	2004	2005
HYBRIDS						
HHB-67	83.11	78.21	17.45	16.51	228.6	224.4
HHB-67-2	94.30	85.33	20.21	18.26	259.7	245.7
SEm ±	0.63	0.59	0.13	0.12	1.7	1.7
CD at 5%	2.01	1.86	0.43	0.39	5.5	5.4
SPACING (cm)						
30 X 12	79.76	73.12	17.23	15.89	231.9	223.2
45 X 12	101.80	94.18	21.44	19.83	273.3	263.4
60 X 12	84.52	78.01	17.82	16.44	227.3	218.7
SEm ±	0.78	0.72	0.17	0.15	2.1	2.1
CD at 5%	2.46	2.28	0.52	0.48	6.8	6.6
FERTILITY LEVELS						
Control	62.90	57.24	12.87	11.74	182.7	175.6
30 kg N +15 kg P_2O_5 ha^{-1}	86.49	78.41	18.60	16.81	241.5	230.7
60 kg N +30 kg P_2O_5 ha^{-1}	101.00	93.25	21.57	19.96	270.8	261.2
90 kg N +45 kg P_2O_5 ha^{-1}	104.4	98.16	22.28	21.03	281.6	272.7
SEm ±	0.62	0.57	0.13	0.12	1.7	1.6
CD at 5%	1.78	1.65	0.38	0.35	4.9	4.7

3.2 Productivity of Pearl Millet

Hybrids HHB 67-2 produced significantly higher grain and stover yield over HHB 67. Spacing of 45x12 cm was found significantly better as compare to other two spacings i.e. 30x12 cm and 60x12 cm in respect of grain and stover yields. The later two spacings were statistically at par. Maximum pooled grain (29.41 q/ha) as well as stover yield (92.83 q/ha) was harvested with 90 kg N + 45 kg ha^{-1} which was at par with 60 kg N + 30 kg P_2O_5 ha^{-1} (Table 1). The results corroborate the findings of Yadav and Jangir (1997).

3.3 Nutrient Content and Uptake

Pearl millet hybrids did not differ significantly in respect of N, P and K content (%) in grain and stover (Table 2). HHB 67-2 had significantly higher total uptake of N, P and K which might be ascribed to its relatively higher grain and stover yield than HHB-67. Corroborative findings have been reported by Sewhag (2003).

Wider spacing of 60 x 12 cm obtained significantly higher N, P and K content in grain and stover than narrow spacing (30 x 12 cm). However, 45 x 12 cm spacing had significantly higher total uptake of N, P and K which might be ascribed to its relatively higher grain and stover yield than wider (60 x 12 cm) and narrow (30 x 12 cm) spacings. Results of almost similar nature were reported by Rathore *et al.* (2004).

The NPK content both in grain and stover increased with increasing levels of fertility. Such results are obvious as application of nitrogen and phosphorus are known to increase the cation exchange capacity of roots and enhance NPK absorption (Elgabaly, 1962) by plants. Corroborative findings have also been reported by Singh (1997). The total NPK uptake was observed to be highest when pearl millet was fertilized with 90 kg N + 45 kg P_2O_5 ha^{-1} during both the years. Since uptake is a function of yield so the treatment producing higher yield also recorded highe uptake. Corroborative findings have been reported by Parihar *et al.* (2005).

References

Economic survey, 2005-06. Economic survey published by Govt. of India, New Delhi.

Elgabaly, M. M. 1962. On the mechanism of anion uptake by plant roots. *Soil Sci.*, **95,** 350-352.

Kumar, S., Kadian, V. S. and Singh, R. C. 2004. Response of pearl millet hybrids to row spacing and nitrogen application. *Ann. Agri. Res.*, **25,** 68-70.

Parihar, M. D., Singh, Harbir, Hooda, R. S, Singh, V. P. and Singh, K. P. 2005. Grain yield, water use, water use efficiency of pearl millet (*Pennisetum glaucum*) hybrids under varying nitrogen applications. *Res. on crops.,* **6,** 209-210.

Rathore, V. S., Singh. P. and Gautam, R. C. 2004. Influence of planting patterns and integrated nutrient management on yield, nutrient uptake and quality of rainfed pearl millet. *Ann. Agric. Res. New Series.* **25,** 373-376.

Sewhag, M., Singh, H., Hooda, R. S. and Khippal, A. 2003. Response of pearl millet [*Pennisetum glaucum* (L.) R. Br. Emend. Stuntz] composites to nitrogen under rainfed conditions. *Crop Res.,* **26,** 67-70.

Sharma, O. P. and Gupta, A. K. 2001. Performance of pearl millet in different intercropping systems with varying levels of fertility. *Annals Agric. Res. New Series.* **22,** 267-270.

Singh, R. 1997. Response of pearl millet genotypes to integrated nutrient management. Ph.D Thesis, CCS Haryana Agricultural University, Hisar.

Yadav, R. S. and Jangir, R. P. 1997. Spatial arrangement of pearl millet (*Pennisetum glaucum*) under different plant densities in arid zone of Rajasthan. *Indian J. Agric. Sci.,* **67**, 318-319.

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