Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(4): 863-865
Received: 05-05-2017
Accepted: 06-06-2017

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Effect of fertility levels and different Pop Corn varieties on productivity, quality and soil fertility

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Abstract
A field experiment was conducted during *Kharif* season of 2016 at Instructional Farm, Rajasthan College of Agriculture, Udaipur to ascertain suitable pop corn variety and its fertility level. Treatment consisted four pop corn varieties *viz*., V L Amber pop corn, BPCH-6, V L pop corn-1 and Jawahar pop corn-11 and four fertility levels *viz*., 90 + 30, 110 + 40, 130 + 50 and 150 + 60 kg N + P_2O_5 ha^{-1}. The soil of experimental site was having medium fertility status. The results indicated that under prevailing agro climatic conditions, pop corn variety "BPCH-6" proved most efficient and economically profitable with highest grain (17.97 q/ha) and stover yield (24.47 q/ha) and gain of net return of ` 19711 ha^{-1} and B-C ratio 0.73 followed by "Jawahar Pop corn-11". The same variety also proved better in grain protein content and popping percentage. At harvest experimental soil with BPCH-6 pop corn had significantly lower N and P status, however K status of soil did not vary significantly. Application of 130 kg N + 50 kg P_2O_5 ha^{-1} produced significantly higher grain (17.76 q ha^{-1}) and stover yield (27.44 q ha^{-1}), protein content (10.97) and also proved economically beneficial with significantly higher net returns (`□16640 ha^{-1}) and B-C ratio (0.52). Application of 150 + 60 kg N + P_2O_5/ha retained significantly higher N and P content in soil. K status did not differ significantly under varying fertility levels.

Keywords: Fertility levels and, Nitrogen, Phosphorus and Pop corn

Introduction
Maize is one of the most important and highly evolved coarse cereals which is widely cultivated around the globe. In India it is an important crop not only in terms of acreage but also in context to its versatility for adoption under wide range of agro-climatic conditions. Currently maize is cultivated over 8.69 m ha area with 21.80 m t production with an average yield of 2509 kg ha^{-1} (Govt. of India, 2016). Out of total production, 25 per cent of maize is consumed as staple food in various forms and among them pop corn is one of the most important one. Pop corn (*Zea mays* L everta) assumes a great significance being nutritionally rich and has high remunerative commercial value (Kumar *et al.,* 2012). Identification of popular pop corn genotype having wider adaptability and responsiveness to input is considered to be first and foremost step for development of production technology. Hence, there is need to test these medium maturing hybrids/composites under prevailing agro-climatic of condition of southern Rajasthan. Further, grain and fodder yield potentials of the pop corn genotypes can realized to the fullest extent when they are grown under adequate fertilization. Research information on the response of pop corn to nutrient application is limited. Hence, the growers are applying the same rate of fertilizers recommended for composite and hybrid corn. Therefore, there is need to work out optimum combination of nitrogen and phosphorus fertilization for pop corn varieties. Considering these facts and paucity of research findings on these aspects in south eastern Rajasthan, the study entitled "effect of fertility levels on different pop corn varieties" was carried out.

Materials and methods
A field experiment was carried out during *kharif* 2016 at the instructional Farm, Rajasthan College of Agriculture, Udaipur, Rajasthan which is situated at 23°34'N latitude, 72°42'E longitude and 582.17 meter above the mean sea level. The soil of experimental site was clay loam in texture, having alkaline reaction (pH 7.6). The soil was medium in available nitrogen (271.4 kg/ha) and available phosphorus (17.4 kg/ha) but high in available potassium (295.9 kg/ha). The treatment consisting 4 pop corn varieties (V L Amber pop corn, BPCH-6, V L pop corn-1 and Jawahar pop corn-11), 4 fertility levels (90 + 30, 110 + 40, 130 + 50 and 150 + 60 kg N + P_2O_5/ha) were tested in factorial randomized block design and replicated thrice. The crop was sown with onset of rain on 6th July 2016.

In well prepared field, furrows were opened at 60 cm apart and seeds were placed manually at a depth of 3-4 cm. As per treatment nitrogen and phosphorus were applied through urea and DAP. One third of nitrogen and full dose of phosphorus were given as basal application at the time of sowing by drilling fertilizer in crop rows about 4-5 cm below the seeds. The remaining nitrogen was given in two equal splits *viz.,* knee high stage and at 50 per cent tasseling stage as top dressing. In order to minimize weed competition, pre-emergence application of atrazine at 0.5 kg/ha followed by one hoeing and earthing up were carried out at 20 and 30 days after sowing, respectively. The standard methods of analysis were adopted for estimation of protein, nutrient in grain and stover and for grain popping per cent. Soil analysis was made following standard procedures. The uptake of macronutrients was calculated by multiplying their respective concentration with grain and stover yield. Data obtained were statistically analyzed in factorial randomized block design using the standard techniques of analysis of variance. To workout the most profitable treatment, economics of different treatments was calculated on the basis of prevailing market prices in terms of net return (/ha) and B-C ratio.

Results and discussion

Performance of varieties

The productivity in terms of grain (17.97 q/ha) and stover yield (27.47 q/ha) realized with variety "BPCH-6" were significantly higher over rest of the varieties. The higher biomass accumulation and its efficient reallocation to sink consequently improved in yield attributes, grain and stover yield of "BPCH-6". The total N, P and k uptake of pop corn grain and stover were significantly higher in variety "BPCH-6" over rest of the varieties. The significant increase in N and P uptake of plant parts at harvest seems to be on account of capabilities of single cross hybrid variety "BPCH-6" for efficient absorption, translocation and utilization of mineral nutrients. The quality parameters *viz.* protein content and popping percentage of grain were significantly higher in "BPCH-6" over rest of the varieties. The improvement in protein content of grain and fodder of single cross hybrid variety "BPCH-6" seems to be on account of increased N content of grain and stover. It is well known fact that N is a constituent of protein, enzymes and chlorophyll and participate in several biochemical processes for the metabolism of carbohydrate and protein in plant system. Thus higher protein might be on account of higher N content compared to other varieties. The results are in close conformity with the findings of Kumar *et al.* (2002), Sani *et al.* (2014) and Meena *et al.* (2017).

The soils under cultivation of "BPCH-6" retained significantly lower N and P compared to rest of the varieties. The N and P status of soil under rest of three varieties were statistically at par. The pop corn varieties failed to record perceptible variations in available K content of soil after harvest of crop. The decrease in available N and P status of soil under pop corn variety "BPCH-6" could be ascribed that added and available soil N and P used were higher by single cross hybrid pop corn variety "BPCH-6" for maintaining its critical concentration for growth and development of plant and capable for sustaining higher yield thus restoration of soil fertility was poor compared to rest of the varieties (Gill *et al.,* 2008). The highest net returns (` 157495/ha) and B:C ratio (5.97) were realized with growing of variety "BPCH-6" which was significantly higher over rest of the varieties. The marked variation in growth, yield and quality parameters of pop corn varieties could be ascribed to their genetic capabilities to exploit available resources for their growth and development (Snehlata *et al.,* 2016 and Meena *et al.,* 2017).

Table 1: Performance of pop corn varieties under varying fertility levels on yield, quality, nutrient status of soil and economics

Treatments	Yield (q/ha)		Nutrient uptake by plant (kg/ha)			Protein content in grain (%)	Popping (%)	Nutrient status of soil (kg/ha)			Net returns (/ha)	B-C ratio
	Grain	Stover	N	P	K			N	P	K		
Varieties												
V L Amber Pop corn	15.80	23.88	41.35	9.32	33.37	10.30	81.22	277.8	18.18	295.8	135274	5.13
BPCH-6	17.97	27.47	51.28	11.36	38.29	11.14	88.50	272.2	17.01	296.2	157495	5.97
V L Pop corn-1	16.03	24.23	44.09	9.26	33.84	10.85	80.46	275.5	17.98	296.9	137660	5.22
Jawahar Pop corn-11	16.10	24.34	43.42	9.34	34.02	10.58	79.47	275.9	17.91	296.2	138342	5.24
SEm±	0.45	0.68	1.31	0.32	1.01	0.05	1.47	1.45	0.21	1.7	4621	0.18
CD (P = 0.05)	1.31	1.97	3.77	0.92	2.92	0.14	4.25	4.19	0.60	5.0	13346	0.51
Fertility levels (kg ha^{-1})												
90 kg N + 30 kg P_2O_5	13.75	19.83	35.33	7.52	27.98	10.32	77.47	269.2	17.18	296.7	115165	4.55
110 kg N + 40 kg P_2O_5	16.08	24.18	43.33	9.40	33.81	10.58	81.77	274.0	17.83	296.5	138418	5.30
130 kg N + 50 kg P_2O_5	17.76	27.44	49.86	10.93	38.17	10.97	84.71	278.5	17.95	296.4	155058	5.85
150 kg N + 60 kg P_2O_5	18.32	28.47	51.63	11.42	39.56	10.99	85.70	279.7	18.12	295.5	160129	5.86
SEm±	0.45	0.68	1.31	0.32	1.01	0.05	1.47	1.45	0.21	1.7	4621	0.18
CD (P = 0.05)	1.31	1.97	3.77	0.92	2.92	0.14	4.25	4.19	0.60	5.0	13346	0.51

Fertility levels

Application of 130 kg N + 50 kg P_2O_5 ha^{-1} recorded significantly higher grain and fodder yield over 110 kg N + 40 kg P_2O_5 ha^{-1} and 90 kg N + 30 kg P_2O_5 ha^{-1}. Advancing nutrient application up to 130 kg N + 50 kg P_2O_5 ha^{-1} significantly increased total N, P and K uptake grain and fodder over 90 kg N + 30 kg P_2O_5 ha^{-1}. It is an established fact that nutrient accumulation depends upon dry matter accumulation and concentration of nutrient at cellular level. The concomitant improvement in both of these components reflected higher accumulation of nutrients with 130 kg N + 50 kg P_2O_5 ha^{-1} fertilization. An application of 130 kg N + 50 kg P_2O_5 ha^{-1} significantly increased protein content and popping percentage of grain over 110 kg N + 40 kg P_2O_5 ha^{-1} and 90 kg N + 30 kg P_2O_5 ha^{-1}. The improvement in protein under the influence of increasing fertility levels seems to be on account of increased N content of grain. After harvest of crop, N and P retained in soil under application of 130 kg N + 50 kg P_2O_5 ha^{-1} were significantly higher over 110 kg N + 40 kg P_2O_5 ha^{-1} and 90 kg N + 30 kg P_2O_5 ha^{-1}. Further increase in fertility level though improved N and P status but failed to record statistical significance. K status did not differ significantly under different fertility levels. After maintaining critical concentration of N and P in plants, the additional N received

from increasing fertility levels and mineralization from native source in soil caused improvement of N and P in soil with increasing fertility levels. The results of present investigation are in line with finding of Dua *et al.* (2013), Kumar *et al.* (2015) and Meena *et al.* (2017).An application of 130 kg N + 50 kg P_2O_5 ha^{-1} proved economically beneficial as it recorded significantly higher net returns and B:C ratio over 110 kg N + 50 kg P_2O_5 ha^{-1} and 90 kg N + 30 kg P_2O_5 ha^{-1}. Further increase in fertility level marginally improved net returns and reduced B C ratio, however, proved statistically at par with preceding level.

Based upon results it is concluded that for profitable pop corn production, variety "BPCH-6" should be grown by fertilizing 130 kg N + 50 kg P_2O_5 ha^{-1}.

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