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RESEARCH PAPER

System productivity and profitability of sweet corn – chickpea cropping system as influenced by land configuration, plant population and integrated nitrogen management

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Abstract : An experiment was conducted on vertisol at the farm of University Department of Agronomy, Dr. PDKV., Akola during *Kharif* and *Rabi* season of 2010-11 and 2011-12, to study the system productivity and profitability of sweet corn – chickpea cropping system as influenced by land configuration, plant population and integrated nitrogen management. Sweet corn yields were significantly higher in ridges and furrow with plant population of 55556 plants ha^{-1} and 100% N through inorganic fertilizer. However, sowing of sweet corn on ridges and furrow with plant population of 55556 plants ha^{-1} (60 x 30 cm^2) along with substitution of 50 per cent N through organic manure (vermicompost) to sweet corn crop exhibited remarkable residual effect on yield and GMR, NMR, B:C ratio of chickpea. This indicates benefits of vermicompost on subsidizing season chickpea than prevailing sweet corn. The system equivalent yield, GMR, NMR, B:C ratio of sweet corn - chickpea cropping sequence was maximum with sowing of sweet corn on ridges and furrow with plant population of 55556 plants per hectare (60 x 30 cm^2) along with application of 100 per cent N through inorganic fertilizers to sweet corn. System production efficiency and economic efficiency were also higher with these treatments.

Key Words : Cropping sequence, Profitability, Sweet corn equivalent yield, Production efficiency

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INTRODUCTION

Maize is one of the most widely grown cereals in the world and has great significance as human food, animal feed and raw material for large number of industrial product. Maize has important role in the world agriculture economy, therefore, called as "Queen of cereals". Maize is one of the worlds leading crop cultivated over an area of 187.51 million ha with a production of about 781.36 million tones and recorded 4.16 tones average yield ha^{-1}. In India, it is grown over

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an area of 8.3 M ha. With total production of about 18 million tones and average yield per ha 2.17 tones (Anonymous, 2008). Sweet corn (*Zea mays* L. Sacharata) also called as Indian corn, sugar corn, is a variety of maize is used for its high sugar content and preferred as a vegetable and human food in the soft dough stage with succulent grain. It is medium plant type and provides green ear in 65 to 75 days after sowing.

It has great market potential and market value in India (Sahoo and Mahapatra, 2007). Chickpea (*Cicer arietinum* L.) is a prime crop of winter season and has good yield potential under both rainfed and irrigated conditions. It is grown only during *Rabi* season as the climate is favourable of its growth and development. Chickpea has unique place in human nutrition and cropping sequence by virtue of its high protein and ability to fix atmospheric nitrogen with the help of root nodule bacteria and it fits well in crop sequence and improves soil health thereby enhancing the total productivity of the sequence. The area under chickpea in India is 8.26 million ha. with total production of 6.20 million tonnes and average yield of 751 kg/ha.. Chickpea is cultivated in 16 states,

Madhya Pradesh, Rajasthan, Uttar Pradesh, Maharashtra and Haryana are major in respect of area. Madhya Pradesh leads with 26.8 Lakh ha. However, Maharashtra rank fourth having area 12.5 lakh ha with a production of 9.13 lakh tones and a productivity of 730 kg ha^{-1} (Anonymous, 2011). Short duration maize (Sweet corn) – chickpea cropping sequence fits well under the uncertain rainfall pattern of semiarid climate with limited facility of irrigation. However, major factors influences the yield are drainage, photosynthase and nitrogen availability (Nagdeve *et al.*, 2008). In view of the above present study is useful to increase the production efficiency of cropping system.

MATERIAL AND METHODS

The experiment on sweet corn - chickpea sequence cropping to integrated nitrogen, plant population and land configuration was conducted at the farm of Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.) during *Kharif* and *Rabi* (winter) seasons of 2010-2011 and 2011-2012. Soil of experimental site was clayey in texture, slightly alkaline in nature (pH 7.8) having moderate organic carbon content, low available nitrogen, low available phosphorus and high available potassium. The experiment was laid out in split plot design with sixteen treatment combinations and four replications. The experiment was carried out on the same site with same randomization during both the years. Gross size of the plot was 5.40x4.80 m while net plot size was 4.20x3.60 m. Treatments consisted of two land configuration practices *viz.,* sowing on flat bed (L_1), sowing on ridges and furrow (L_2), two plant population treatments *viz.,* plant population at the spacing 40 x 30 cm (S_1 – 74074 plants ha^{-1}), plant population at the spacing 60 x 30 cm (S_2 – 55556 plants ha^{-1}) as main plot treatments and four nitrogen management practices *viz.,* 100 per cent N through inorganic fertilizer (N_1), 75 per cent N through inorganic fertilizer + 25 per cent N through vermicompost (N_2), 50 per cent N through inorganic fertilizer + 50 per cent N through vermicompost (N_3), application of vermicompost @ 2.5 t per hectare as sub plot treatments. Thus, there were 16 treatment combinations. The sowing of sweet corn was done on 30th June and 1st July 2010 and 2011, respectively. The land configuration *i.e.* sowing of sweet corn on flat bed and ridges and furrow was done as per treatments. The plant population was also kept as per treatments. The nitrogen through vermicompost and nitrogen through inorganic fertilizer were given as per treatments. *Azatobacter* and PSB seed inoculation was done commonly to all treatments. The 50 per cent dose of N to be given and full dose of P_2O_5 and K_2O were applied at the time of sowing and remaining 50 per cent dose of N was applied in two equal split doses. The vermicompost was well mixed in the entire plots before sowing. The recommended dose of fertilizer was applied @ 120:60:30 NPK/ha. The chickpea was sown on 20th Oct. 2011 and 22nd Oct. 2012, on same layout and same treatments with two irrigations each at flowering and pod development stage. The chickpea was not fertilized with inorganic fertilizer In *Rabi* season. The chickpea variety ICCV-2 was used and sowing was done at the spacing 30 x 10 cm^2. All the recommended practices were followed as per requirements during the life cycle of the crops.

Sweet corn equivalent yield (kg ha^{-1}):

The economic produce of chickpea crop in the sequence can be compared by converting the yield of chickpea into equivalent yield of sweet corn. The equation for calculating sweet corn equivalent yield (SEY) as suggested by Verma and Modgal (1983).

$$SEY = \sum_{i=1} (Yi, ei)$$

where,

SEY – Sweet corn equivalent yield (kg ha^{-1})

Y - Economic yield of 1 to n number of crops

e – Sweet corn equivalent factor which can be calculated as:

$$\frac{PC}{PS}$$

where,

PC - Price of unit weight of concerned crop

PS - Price of unit weight of sweet corn

i - 1 to n number of crops.

Production efficiency:

Production efficiency of the sweet corn system in terms of kg day^{-1} ha^{-1} was worked out by dividing the total production of the cropping system with total duration of the system (Singh and Verma, 1998).

$$\text{Production efficiency } (kg\ day^{-1} ha^{-1}) = \frac{\text{Total productivity of system } (kg\ ha^{-1})}{\text{Cropping period (days)}}$$

Economic efficiency:

This index gives the efficiency of the cropping system in terms of monetary value. It is estimated as given below.

$$\text{Economic efficiency } (Rs.\ day^{-1}\ ha^{-1}) = \frac{\text{Net returns } (Rs.\ ha^{-1})}{\text{Cropping period (days)}}$$

Land utilization efficiency:

Land utilization efficiency (LUE) was estimated by dividing the total duration of different crops in a sequence with 365 days and expressed in percentage (Tomar and Tiwari, 1990).

$$\text{Land utilization efficiency } (\%) = \frac{\text{Total duration of sequence}}{365} \times 100$$

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Crop yields:

The yield of sweet corn was (Table 1) significantly improved with sowing of sweet corn on ridges and furrow with plant population 55556 plants ha^{-1} along with 120 kg N through fertilizers in the year 2010-11 and 2011-12. The residual effect of land configuration and plant population on grain yield of chickpea was non-significant in both the years. Nitrogen management at different level and from different sources to sweet corn in *Kharif* significantly influenced the grain yield of chickpea as a residual effect during both the years of experimentation. Treatment N_3 (50% N through inorganic fertilizer + 50% N through vermicompost) recorded maximum grain yield of chickpea as a residual effect over 100% N through inorganic fertilizer, 75% N through inorganic fertilizer + 25% N through vermicompost and vermicompost @ 2.5 tone per hectare during both the years. In pooled analysis same trend was noticed. Similar results were obtained by Thakur *et al.* (2003) and Abraham and Lal (2003).

System productivity:

Sweet corn equivalent yield of the system was significantly influenced due to land management practices and plant population during both the years. Ridges and furrow land layout and plant population, 555556 plants ha^{-1} recorded significantly higher sweet corn equivalent yield as compared to flat bed and plant population 74074 plants ha^{-1} during 2010-11 and 2011-12, respectively. Similar results were recorded by Ramakichenin *et al.* (2002) The higher sweet corn equivalent yield might be due to proper utilization of moisture and its residual availability that related in more cell division, better crop growth and ultimately higher grain yield, these findings are in close conformity with those reported by Kumar and Puri (2001) in maize-chickpea cropping system.

Sweet corn equivalent yield of the system was significantly influenced due to nitrogen management practices during the year 2010-11 and 2011-12, respectively. Sweet corn equivalent yield was (Table 1) significantly improved with 120 kg N through inorganic fertilizers during both the years . In pooled analysis same trend was noticed. Similar results are recorded by Singh *et al.* (2010).

Ridges and furrow land layout was found significantly superior in recording maximum production efficiency of sweet corn-chickpea cropping system than flat bed during both the years of experimentation. Data representing production efficiency of cropping system was significantly influenced due to plant population treatment during both the years of experimentation. The plant population 555556 plants ha^{-1} recorded significantly higher production efficiency of the system as over plant

Table 1 : Sweet corn equivalent yield (q ha^{-1}), production efficiency (kg day^{-1} ha^{-1}) economic efficiency (Rs. day^{-1} ha^{-1})and Land utilization efficiency (%) of sweet corn -chickpea cropping system a influenced by different treatments during 2010-11and 2011-12

Treatments	Cob/grain yield q ha^{-1}				Fodder/straw yield (q ha^{-1})				Sweet corn – chickpea equivalent yield (q ha^{-1})		Economic efficiency (Rs. day^{-1} ha^{-1})		Production efficiency of system (kg day^{-1} ha^{-1})		Land utilization efficiency (%)	
	Sweet corn 2010-11	Chickpea 2010-11	Sweet corn 2011-12	Chickpea 2011-12	Sweet corn 2010-11	Chickpea 2010-11	Sweet corn 2011-12	Chickpea 2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
Main plot treatments																
Land configuration																
L_1 - Flat bed	142.94	12.37	132.32	11.12	118.83	17.01	120.57	16.04	147.87	135.52	787.56	688.26	91.36	84.38	45.87	45.68
L_2 - Ridges and furrow	163.24	12.45	156.74	11.32	138.97	18.17	131.09	16.94	166.78	159.72	910.36	797.02	103.35	98.86	46.00	45.70
S.E.±	5.083	0.314	4.760	0.245	6.27	0.543	1.56	0.397	5.27	5.09	29.40	33.63	3.11	2.81	0.09	0.10
C.D. (P=0.05)	16.175	NS	15.147	NS	19.95	NS	4.94	NS	16.75	16.23	93.55	107.02	9.92	8.94	NS	NS
Plant population																
S_1 – 45 x 30 cm (74074 plants ha^{-1})	133.66	12.15	127.72	10.79	112.54	17.62	109.57	16.44	138.68	130.95	729.57	599.64	85.77	81.48	45.86	45.80
S_2 – 60x30 cm (55556 plants ha^{-1})	172.52	12.58	161.33	11.66	145.26	17.91	142.09	16.54	175.96	164.31	971.58	885.65	108.88	101.76	46.01	45.57
S.E.±	3.595	0.193	3.367	0.344	4.44	0.355	1.098	0.251	3.72	3.61	20.79	23.79	2.20	1.99	0.06	0.08
C.D. (P=0.05)	16.174	NS	15.147	NS	19.95	NS	4.94	NS	16.75	16.23	93.55	107.02	9.92	8.94	NS	NS
Sub plot : Integrated nitrogen management																
N_1 – 100 % N through inorganic fertilizers	207.9025	10.93	186.09	9.18	154.17	14.93	147.84	13.91	210.44	187.88	1100.48	955.90	128.72	114.86	46.10	45.82
N_2 – 75% % N through inorganic fertilizers+ 25% N through vermicompost	167.155	12.14	159.655	11.01	141.07	17.18	138.26	16.12	170.52	162.29	929.19	852.48	105.47	100.39	46.04	45.75
N_3 - 50% N through inorganic fertilizers + 50 % N through vermicompost	140.6906	13.80	138.8156	12.86	113.76	19.78	112.70	18.97	145.54	142.81	758.24	687.47	90.88	89.22	45.82	45.68
N_4 – Vermicompost @ 2.5 tone ha^{-1}	96.61	12.78	93.55	11.85	106.59	18.45	104.53	16.95	102.13	120.99	610.67	474.73	64.35	61.99	45.79	45.50
S.E.±	4.903	0.328	4.201	0.334	5.92	0.406	2.93	0.373	4.93	4.09	25.60	27.96	2.92	2.51	0.10	0.10
C.D. (P=0.05)	14.003	0.937	11.998	0.954	16.91	1.159	8.37	1.063	14.09	11.70	73.11	79.85	8.34	7.19	--	--
Interaction (LxSxN)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
G. M.	153.04	12.41	144.53	11.23	128.90	17.59	125.83	16.48	157.15	153.49	849.64	742.64	97.35	91.62	45.94	45.69

NS= Non-significant

population 74074 plants ha^{-1}. During both the years of study application of 100% N through inorganic fertilizer recorded significantly higher production efficiency of the system over other treatments. These results are in agreement with Tomar *et al*. (1996).

Ridges and furrow to the sweet corn recorded significantly greater economic efficiency than flat bed layout during both the years. Mean economic efficiency was also greater with ridges and furrow land layout. Data related to economic efficiency of cropping system was significantly influenced due to plant population during the year 2010-11 and 2011-12, respectively. The sweet corn population 55556 plants ha^{-1} recorded significantly greater economic efficiency over plant population 74074 plants ha^{-1}. Application of 100% N through inorganic fertilizer marked significantly higher economic efficiency of cropping system over other treatments during both the years of experimentation. The land utilization efficiency was found non-significant.

Economics :

The gross monitory returns (Table 2) in terms of rupees per hectare were worked out on the basis of green cob yield and dry fodder yield of each treatment and grain yield and straw yield of chickpea, taking in to account prevailing market prices. The net returns obtained by deducting the cost of cultivation from the gross returns. The benefit cost ratio was calculated by dividing the gross returns by the total cost of cultivation of each treatment

The highest system gross, net returns and B:C ratio was recorded with sowing of sweet corn on ridges and

Table 2 : Gross monetary returns, net monetary returns (Rs. ha^{-1}), B:C ratio of sweet corn-chickpea cropping system as influenced by different treatments during 2010-11and 2011-12

Treatments	Gross monetary return (Rs. ha^{-1})			Net monetary return (Rs. ha^{-1})			B:C ratio		
	2010-11	2011-12	pooled	2010-11	2011-12	pooled	2010-11	2011-12	Pooled
Main plot treatments:									
Land configuration									
L_1 - Flat bed	215914	205081	210498	133886	117005	123846	4.94	4.42	4.68
L_2 - Ridges and furrow	236505	223945	230225	154762	135494	143128	5.59	5.12	5.36
S.E.±	4997.8	5717.8	5358	4997.8	5717.8	5358	0.114	0.109	0.09
C.D. (P=0.05)	15903.1	18194.0	17049	15903.1	18194.0	17049	0.364	0.347	0.30
Plant population									
S_1 – 45x30 cm (74074 plants ha^{-1})	204078	192962	198520	124027	101939	108983	4.69	4.23	4.46
S_2 – 60x30 cm (55556 plants ha^{-1})	248340	236063	242202	165169	150560	157965	5.83	5.31	5.57
S.E.±	3534.5	4043.7	3789	3534.5	4043.7	3789	0.081	0.077	0.07
C.D. (P=0.05)	15903.1	18194.0	17049	15903.1	18194.0	17049	0.364	0.347	0.30
Sub plot : Integrated nitrogen management									
100 % N through inorganic fertilizers	262954	240946	251950	187081	162502	174792	6.13	5.36	5.74
N_2 – 75% % N through inorganic fertilizers+25% N through vermicompost	244506	234295	239400	157962	144921	151442	5.40	4.94	5.17
N_3 - 50% N through inorganic fertilizers + 50 % N through vermicompost	226054	216903	221479	128900	116870	122885	5.01	4.62	4.81
Vermicompost @ 2.5 tone ha^{-1}	186184.	165905	176045	103813	80705	92259	4.51	4.17	4.34
S.E.±	4351.3	4752.5	3675.2	4351.3	4752.5	3675.2	0.084	0.097	0.07
C.D. (P=0.05)	12428.7	13574.4	10497.3	12428.6	13574.4	10497.3	0.239	0.276	0.21
Interaction (L x S x N)	NS	NS	NS	NS	NS	NS	NS	NS	NS
G. M.	229925	214512	222219	144439	126249	135344	5.26	4.77	5.02

Selling price: Sweet corn — Large size - 3 Rs./ cob; Small size - 1 Rs. / cob; Fodder - 150 Rs. / Qt
Chickpea — Grain - 3700 Rs. / Qt; Straw – 200 Rs. / Qt
NS= Non-significant

furrow with population 55556 plants ha^{-1} along with 120 kg N through inorganic fertilizers during both the years. The pooled maximum gross, net returns was 230225, 242202 and 251950 , 143128, 157965 and 174792 Rs. per hectare and B:C ratio was 5.36, 5.57 and 5.74. The gross, net returns and B:C ratio of the system were unsatisfactory due to the treatment sowing of sweet corn on flat bed, with plant population 74074 plants per hectare and integrated nitrogen management through vermicompost @ 2.5 t per hectare. These findings are conformity with the findings of Chaurasia and Gupta (2003) and Zende *et al.* (2009).

Interaction effect:

None of the interaction effect on yield of sweet corn and chickpea and its system equivalent yield, production efficiency, economic efficiency and land utilization efficiency was significant during both years.

Conclusion:

Land configuration practices, sowing of sweet corn on ridges and furrow in population of 55556 plants ha^{-1} (60 x 30 cm) along with application of 100 per cent N through inorganic fertilizer (120 kg N ha^{-1}) + biofertilizers (*Azatobacter* and PSB) recorded maximum sweet corn-chickpea productivity.

The land configuration practices, sowing of sweet corn in plant population 55556 plants ha^{-1} (60 x 30 cm) with substitution of 50 per cent N through organic manure (vermicompost) along with biofertilizers to sweet corn crop caused marked residual effect on yield and GMR, NMR, BC ratio of chickpea. However, GMR, NMR, BC ratio of sweet corn-chickpea cropping sequence were maximum with sowing of sweet corn on ridges and furrow in population of 55556 plants ha^{-1} (60 x 30 cm) along with application of 100 per cent N through inorganic fertilizers to sweet corn.

REFERENCES

Abraham, T. and Lal, R.B. (2003). Strategies for INM technology in sustainable edapho-cultivar management for a legume based (soybean-mustard-fodder cowpea) cropping system for the inceptisol. *Crop Research-Hisar,* **26** (1) : 33-41.

Anonymous (2008). Corn area, yield and production-*http:// www.fas.usda.gov/ pseuonline/ psdhom.aspx.*

Anonymous (2011). *http://en.wikipedia.org/wiki/sweet_corn*

Chourasia, S.K. and Gupta, M.P. (2003). Effects of fertilizer levels on chickpea. *JNKVV Res. J.*. **37** (2): 81-82.

Kumar, P. and Puri, U.K. (2001). Effect of nitrogen and FYM application on maize (*Zea mays* L.) varieties. *Indian J. Agron.*, **46** (2): 255-259.

Nagdeve, M.B., Giri, M.D. and Ganvir, M.M. (2008). Effect of potassium application and moisture conservation practices on yield of cotton (*Gossypium hirsutum*). *Indian J. Dry Land Agric. Res. & Develop.,* **23** (2): 10-13.

Ramakichenin, B., Sakthivel, N. and Balasubramanian, A. (2002). Effect of premansoon sowing and land management practices on growth, yield parameters and yield of rainfed maize. *Madras Agric. J.,* **89** (1-3) : 177-179.

Sahoo S.C. and Mahapatra, P.K. (2007). Yield and economics of sweet corn (*Zea mays*) as affected by plant population and fertility levels. *Indian J. Agron.,* **52**(3): 239-242.

Singh, M.K., Singh, R.N., Yadav, M.K. and Singh, V.K. (2010). Integrated nutrient management for higher yield, quality and profitability of baby corn (*Zea mays*). *Indian J. Agron.,* **55**(2): 100 -104.

Singh, N. B. and Verma, K. K. (1998). Production potential and economic analysis of rice – based cropping system. *Indian J. Agron.,* **43** (2) : 199-203.

Thakur, H. S., Grothia, O. P., Holkar, S. and Sharma, R. A. (2003). Effect of land treatments on productivity of rainfed maize (*Zea mays* L.) varieties grown on Vertisols of Madhys Pradesh. *Crop Res.,* **26**(1): 75-78.

Tomar, R.K.S., Namdeo, K.N. and Raghu, J.S. (1996). Productivity and economics of double cropping with pulses and oilseed against the base crop wheat (*Triticum aestivum*). *Indian J. Agron.,* **41** (2) : 205-208.

Tomar, S. S. and Tiwari, A. S. (1990). Production potential and economics of different crop sequences. *Indian J. Agron.*, **35** (1&2) : 30-35.

Venketraman, N. S. (2007). Need of corn revolution in India. *Kisan World,* 22-23.

Verma, S. P. and Modgal, S. C. (1983). Production potential and economics of fertilizer application as resource constraints in maize – wheat crop sequence. *Himachal J. Agric. Res.,* **9** (2) : 89-92.

Zende, N.B., Pinjari, S.S., Suryawanshi, J.S. and Bhondve, T.S. (2009). Effect of nutrient management on growth, yield, quality, economics and nutrient partitioning of sweet corn. *Bioinfolet,* **6** (1): 16-21.