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Impact of integrated nutrient management on physiological nutrient efficiency and economics of baby corn (*Zea mays* L.)

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Abstract

Presently baby corn is gaining popularity among Indian farming communities mainly due to its short duration, high market rate, nutritive value and also its multiuse. Corn responds high to nutrients because of its fast growth. Therefore integrated nutrient management, efficiency of nutrient supply and economics of baby corn under INM for is of immense importance for higher profitability of corn production. The present study was thus carried out during *Kharif* season 2015 at the Instructional Dairy Farm (IDF), Nagla, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand to study physiological nutrient efficiency and economics of baby corn production under the effect of integrated nutrient management. The experimental design was Randomized Block Design with 11 treatments consisting of sole application of NPK fertilizer, sole application of *Azotobacter* and *Azospirillum*, and application of *Azotobacter* and *Azospirillum* along with NPK fertilizer. The highest physiological nitrogen efficiency was recorded at seed treatment with *Azotobacter* that remained non significant with 50% NPK and seed treatment with *Azospirillum*. Similarly, the highest physiological phosphorus efficiency was recorded at seed treatment with *Azotobacter* and remained non significant with seed treatment with *Azospirillum* and the highest physiological potassium efficiency was recorded at seed treatment with *Azospirillum*. Significantly highest gross return, net return and net profit per day were found at application of 100% NPK+*Azot*+*Azos* that remained significantly at par with 75% NPK+*Azot*+*Azos*. The treatments applied with 100% NPK+*Azot*+*Azos* gave 7.62 and 10.1% higher gross and net returns, respectively than alone application of 100% NPK. The treatments applied with 100% NPK+*Azot*+*Azos* gave 3.6% and 2.7% higher gross and net returns, respectively than application of 75% NPK+*Azot*+*Azos*. B:C ratio was found significantly higher at 75% NPK+*Azot*+*Azos* that remained non significant with 50% NPK+*Azot*+*Azos* and 100% NPK+*Azot*+*Azos*. The study thus revealed the profitability of combined application of chemical and biofertilizers for nutrient efficiency and economic crop production.

Keywords: *Azotobacter*, *azospirillum*, physiological efficiency, net returns, gross returns

Introduction

The demand of baby corn is increasing day by day in countries like USA, Japan, Singapore, Australia, Canada, New Zealand and Arab countries. India also has a great potential and may lead in the world mainly because of suitable weather conditions throughout the year. Among the Indian states, Meghalaya, Bihar, Western UP, Haryana, Punjab, Maharashtra, Karnataka and Andhra Pradesh are the leading states in baby corn production. The net income from baby corn is four to five times higher from a single crop than grain maize crop. In addition, the net income from baby corn can be multiplied by growing of 3-4 crops of baby corn in a year. Due to increasing awareness about health coupled with high income the demand of baby corn is increasing in Indian market. Therefore, the acreage as well as the production of baby corn is increasing in India. It has been observed that there is a high demand of baby corn in super mall and star hotels near the metropolis and big cities where it is sold from Rs 50 to 200 per kg. It indicates that baby corn has a good feature in Indian market. In addition, baby corn requires higher population and plant nutrition than normal grain corn. So to plan an integrated nutrient management for baby corn that provides greater nutrient efficiency as well as better economics for baby corn production is very important. Pandey *et al.* (2000) [5] reported that application of 120 kg N ha⁻¹ gave significantly higher yield and more net return compared with 60 and 90 kg ha⁻¹, respectively and benefit:cost ratio was also highest. Higher net returns by maize was obtained by the application of 137 lb P₂O₅ acre⁻¹ compared to lower levels of P and N in three years (Reetz *et al.*, 2001) [6]. The higher net return of maize (20,951 ha⁻¹) and benefit cost ratio (2.92) was observed by application of 150% RDF compared to 100% RDF + 10 t FYM ha⁻¹ (Kumar *et al.*, 2002) [3]. A field experiment was conducted by Kumar *et al.* (2005) [4] in

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Himachal Pradesh and worked out an integrated nutrient management schedule for maize-gobhi sarson cropping system under rainfed condition and the experimental results showed that the total grain production was significantly higher (110.5 q ha⁻¹ when both crops in system were given 150% of recommended NPK. The gross returns (56,786 ha⁻¹) and benefit cost ratio (2.68) were also higher in the same treatment. Kumar (2008) [2] revealed that higher net return of 41,590 ha⁻¹ and 49,420 ha⁻¹ by pop corn and sweet corn was found at higher nitrogen level of 120 kg ha⁻¹ compared to lower levels. The higher net returns were directly contributed by higher grain yield of pop corn (3.48 t ha⁻¹) and green cobs of sweet corn (13.46 t ha⁻¹). Das *et al.* (2009) [1] reported that 120 kg N ha⁻¹ gave highest yield (51.48 q ha⁻¹) with maximum net profit of Rs 144,900 ha⁻¹ with a B: C ratio of 11.32. These studies also highlighted such importance. But the exact study on baby corn was lacking and so this study was planned to study physiological nutrient efficiency and economics of baby corn production under the effect of integrated nutrient management.

Material and methods

The experiment was conducted at the Instructional Dairy Farm (IDF), Nagla, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar, Uttarakhand, India. The Instructional Dairy Farm is located in the *Tarai* belt of Shivalik range of Himalayas with humid sub-tropical type of climate at latitude of 29°N and longitude of 79.3°E and situated at an altitude of 243.84 m above the mean sea level. The climate of the *Tarai* region is broadly humid sub-tropical with harsh winter and hot dry summers. The soil of the experimental field was slightly silty clay loam (Nagla series, Mollisol) in texture, from dark greyish brown to dark grey in humus with weak, fine to medium granular structure. Eleven treatments were tested in a Randomized Block Design 3 replications the treatments were Control (no application), 50% NPK, 100% NPK(180:60:40), Seed treatment with *Azotobacter* @200g/10Kg seeds, Seed treatment with *Azospirillum* @200g/10Kg seeds, Seed treatment with *Azospirillum* + *Azotobacter*, 50% NPK + Seed treatment with *Azotobacter*, 50% NPK + Seed treatment with *Azospirillum*, 50% NPK+ Seed treatment with *Azospirillum* + *Azotobacter*, 50% NPK+ Seed treatment with *Azospirillum* + *Azotobacter* and 100%NPK+seed treatment with *Azospirillum* + *Azotobacter*. The variety sown was V.L. Baby corn-1 – released from Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora, Uttarakhand.

Results and discussion

Physiological Nutrient Efficiency (PHNE)

Physiological Nitrogen Efficiency (PHNE)

Significantly higher PHNE was recorded at seed treatment with *Azotobacter* that remained non significant with seed treatment with *Azospirillum* and 50% NPK. The lowest PHNE was found with application of 100% NPK+*Azot*+*Azos* that was non significant with 100% NPK, 50% NPK + Biofertilizers and 75% NPK+*Azot*+*Azos*.

Physiological Phosphorus Efficiency (PHPE)

The highest PHPE was recorded at seed treatment with *Azotobacter* that was non significant with seed treatment with *Azospirillum* but the lowest value was found under 100% NPK+*Azot*+*Azos* that remained statistically at par with 100% NPK, 50% NPK+*Azot*+*Azos* and 75% NPK +*Azot*+*Azos*. Among the biofertilizer treatments, seed treatment with *Azospirillum* and *Azot*+*Azos* remained non significant with each other, whereas the highest PHPE was recorded at seed treatment with *Azotobacter*.

Physiological Potassium Efficiency (PHKE)

The highest PHKE was also recorded at seed treatment with *Azospirillum*. The lowest PHKE was recorded with 100% NPK+*Azot*+*Azos* that remained non significant with 100% NPK and 75% NPK+*Azot*+*Azos*. Among the biofertilizer treatments, seed treatment with *Azotobacter* and *Azot*+*Azos* remained non significant with each other.

The higher physiological N, P and K efficiencies were the result of higher dry matter production compared to total nutrient uptake. The data pertaining to Physiological Nutrient Efficiency (PHNE) is given in table 1.

Economics

Significantly higher gross return, net return and net return per day were found with application of 100% NPK+*Azot*+*Azos* that remained significantly at par with 75% NPK+*Azot*+*Azos* but 100% NPK recorded significantly higher gross return, net return and net return per day than all other treatments except 75% NPK+*Azot*+*Azos* and 100% NPK+*Azos*+*Azos*. Among the alone application of the biofertilizer treatments, the highest gross return, net return and net return per day were recorded at seed treatment with *Azot*+*Azos* followed by seed treatment with *Azotobacter*. The seed treatment with *Azotobacter* gave 29.8% and 53% higher gross and net returns, respectively than control. Similarly, the *Azospirillum* had 12.3% and 21.9% more gross and net returns, respectively than control but the combined application of *Azot*+*Azos* gave 43.7% and 77% greater gross and net returns, respectively than control indicating beneficial effect of seed treatment with biofertilizers.

The B:C ratio was recorded significantly higher with application of 75% NPK+*Azot*+*Azos* that remained statistically at par with 50% NPK+*Azot*+*Azos* and 100% NPK+*Azot*+*Azos*. The highest B:C ratio was recorded at seed treatment with *Azot*+*Azos* followed by seed treatment with *Azotobacter* among the treatments where alone biofertilizers were applied.

The greater values of gross return, net return and B: C ratio under either alone or combined application of biofertilizers with chemical fertilizers were due to higher baby corn and green fodder yield. The data pertaining to economics of baby corn production is given in table 2.

Table 1: Physiological N, P and K efficiencies of baby corn under different integrated nutrient management practices

Treatment	Physiological Nutrient Efficiency (PHNE) kg/ha		
	Nitrogen	Phosphorus	Potassium
Control	0	0	0
<i>Azotobacter</i>	55.0	429.3	36.3
<i>Azospirillum</i>	54.4	425.4	39.6
<i>Azot</i> + <i>Azos</i>	52.4	370.0	34.4
50% NPK	53.1	355.3	36.2
100% NPK	51.3	315.0	32.1
50% NPK + <i>Azotobacter</i>	52.3	340.0	36.3
50% NPK + <i>Azospirillum</i>	52.4	331.6	36.8
50% NPK + <i>Azot</i> + <i>Azos</i>	51.0	307.2	33.9
75% NPK + <i>Azot</i> + <i>Azos</i>	51.0	327.0	32.0
100% NPK + <i>Azot</i> + <i>Azos</i>	50.6	296.3	30.7
SEm±	0.7	10.4	1.0
LSD (p=0.05)	2.0	30.7	2.9

Table 2: Effect of integrated nutrient management on cost of cultivation, gross return, net return, B:C ratio and net profit per day

Treatment	Cost of Cultivation (Rs/ha)	Gross return (RS/ha)	Net return (Rs/ha)	B:C ratio	Net profit/day (Rs)
Control	19965	45364	25399	1.27	423
<i>Azotobacter</i>	20010	58893	38883	1.94	648
<i>Azospirillum</i>	20010	50980	30970	1.55	516
<i>Azot</i> + <i>Azos</i>	20055	65208	45153	2.25	753
50% NPK	23065	75520	52455	2.27	874
100% NPK	26165	100399	74234	2.84	1237
50% NPK + <i>Azotobacter</i>	23110	90240	67130	2.90	1119
50% NPK + <i>Azospirillum</i>	23110	87137	64027	2.77	1067
50% NPK + <i>Azot</i> + <i>Azos</i>	23155	94122	70967	3.06	1183
75% NPK + <i>Azot</i> + <i>Azos</i>	24685	104304	79619	3.23	1327
100% NPK + <i>Azot</i> + <i>Azos</i>	26255	108053	81798	3.12	1363
SEm±	-	1771	1771	0.08	30
LSD (p=0.05)	-	5263	5263	0.23	88

1. Rate of fresh baby corn = Rs. 50/kg
2. Rate of green fodder = Rs. 20/q

Conclusion

It is therefore concluded that the profitability of baby corn as well as physiological nutrient efficiency may be increased with application of 75% NPK coupled with seed treatment by both *Azotobacter* and *Azospirillum* in Indo-Gangetic plains of India and 25% NPK can be saved compared to application with 100% NPK+*Azot*+*Azos*.

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