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Response of nitrogen and planting pattern to growth and yield in maize (*zea maize l.)* Intercropped with cowpea *(Vigna unguinculata)*

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Abstract
A field experiment was carried out to study "Response of nitrogen and planting pattern in maize (*Zea maize L.)* Inter cropped with cowpea *(Vigna unguinculata)*" during *kharif* season of 2019-20 at Agronomy Farm, College of Agriculture, Nagpur. The experiment was laid out in Factorial Randomized Block design with three replications. Treatment comprises Planting pattern and Nitrogen dose. Four planting pattern in factor A treatment studied with sole maize (P_1), maize + cowpea 1:1 (P_2), maize + cowpea 2:1 (P_3), maize + cowpea 2:2 (P_4) and three factor B treatments of nitrogen dose viz. application of 100% RDN (N_1), 125% RDN (N_2), 150% RDN (N_3) were studied. Growth characters of maize *viz*. plant height, number of leaves plant^{-1}, dry matter accumulation plant^{-1} (g) and yield attributes and yield such as number of cobs plant^{-1}, weight of cobs plant^{-1}, weight of grains cob^{-1}, grain yield plant^{-1} (g) of maize was significantly higher with planting pattern of maize + cowpea 2:2 (P_4) and application of 150% RDN followed by maize + cowpea 2:1 (P_3) and application of 125 % RDN.

Keywords: maize, cowpea, planting pattern, nitrogen dose

Introduction

Intercropping is a potentially beneficial system, shows substantial yield advantage over sole cropping and reduces risk. In addition to that, an intercropping system can exploit the environment and physical resources more efficiently which may result into more production, productivity as well as economically viable system with minimum exploitation of land resources or even improving the soil fertility and brings stability under rainfed conditions. Normal plant population with adequate spatial arrangement in intercropping have important effect on the equal or least competition between the component crops with enhancement in total production.

Intercropping plays an important role in sustainable agricultural system as it improves the productivity and stability of yield and helps in soil conservation. The most important benefit of intercropping is the increase in production per unit area as compared to sole crop. Intercropping makes better use of production elements like water, nutrient, light, space etc. As the cultivable area in India is decreasing day by day, intercropping is becoming popular among the small farmers, particularly in the area where there is a risk of crop failure. So when legumes are grown in association with non-legumes, it is advantageous to non-legume crops due to nitrogen fixation by legumes. So growing of legume in an intercropping is becoming popular among the farmers.

Maize (*Zea mays* L.) is one of the most versatile emerging crops having wider adaptability under varied agro-climatic conditions. Globally, maize is known as "queen of cereals" because it has the highest genetic yield potential among cereals. It is not only an important food crop for human, but also a basic element of animal feed, fodder and raw material for manufacturing of many industrial products. Maize contains about 72% starch, 10% protein, 4.8% oil, 8.5% fibre, 3.0% sugar and 1.7% ash (Afridi *et al*. 2016) [1]. Cowpea (*Vigna unguiculata* L) is a legume of African origin and one of the most ancient crops ever domesticated by man. Cowpea is highly adaptable to grow in different soil types and intercropping systems. It is drought resistant and has the ability to improve soil fertility through biological nitrogen fixation and also reduces the risk of soil erosion.

Material and methods

The field experiment was carried out in Agronomy section Farm, College of Agriculture, Nagpur during *Kharif* season of 2019-20 to study "Response of nitrogen and planting pattern in maize (*Zea maize L.)* Intercropped with cowpea *(Vigna unguinculata)*. The soil of the experimental plot was clayey in texture, Organic carbon (0.60%), low in available nitrogen (220.52 kg ha^{-1}), low in available phosphorus (18.78 kg ha^{-1}) and very high in available potash (362.06 kg ha^{-1}) with pH 7.75. The experiment was laid out in a factorial randomized block design with 12 treatment combinations consisted of four planting pattern [Sole maize (P_1), Maize + cowpea (1:1) (P_2), Maize + cowpea (2:1) (P_3) and Maize + cowpea (1:1) (P_4) and nitrogen dose [100 RDN (N_1), 125 RDN (N_2), 150 RDN (N_3). The recommended dose of fertilizer 160:60:40 kg NPK ha^{-1} of was applied in the form of urea and single super phosphate, respectively as soil application at the time of sowing.

Result and Discussion

Effect of Planting Pattern

The growth attributes attributes viz. plant height, number of leaves plant^{-1}, dry matter accumulation plant^{-1} (g) of maize

was significantly affected by planting pattern. Plant height, number of leaves plant^{-1} and dry matter accumulation plant^{-1} (g) of maize at 30 DAS was found non-significant. At harvest, planting pattern of maize + cowpea 2:2 (P_4) recorded higher plant height (201.67cm), number of leaves plant^{-1} (10.06) and dry matter accumulation plant^{-1} (162.26 g) over rest of all other planting patterns. The results obtained during investigation are in close conformity with the findings of Panhwar *et al.* (2004) and Yadav and Dawson (2015) [11] reported that intercropping of soybean in maize rows increased plant height, no. of leaves plant^{-1} and dry matter accumulation plant^{-1} (g) due to maize-legume intercropping system. Kumar *et al.*, (2014) [5] and Morgado and Willey (2003) [7] reported that the increase in fresh weight at harvest might be due to increased plant height, stem girth and leaves plant^{-1}.

Yield attributes viz. number of cobs plant^{-1}, weight of cobs plant^{-1}, weight of grains cob^{-1}, grain yield plant^{-1} (g) of maize was significantly affected by planting pattern. Planting pattern of maize + cowpea 2:2 (P_4) recorded significantly higher number of cobs plant^{-1} (1.34), Weight of cob plant^{-1} (179.34 g), weight of grains cob^{-1} (60.68 g) and grain yield plant^{-1} (80.60 g) however, it was at par with maize + cowpea 2:1 (P_3) among all planting pattern. Patra *et al.* (2000) and Jat *et al.* (2014) reported increased number of cobs plant^{-1} due to maize legume intercropping. Rashwan and Zen El-Dein (2017) [10] indicated that, grain yield per ear (for maize), were found with treatment intercropping patterns 2 maize: 4 soybean.

Effect of Nitrogen dose

The growth attributes viz. plant height, number of leaves plant^{-1}, dry matter accumulation plant^{-1} (g) of maize was significantly affected by various nitrogen doses. Data revealed in Table 1 that treatment difference due to nitrogen dose was found significant at 60 DAS, 90 DAS and at harvest. At harvest, the maximum plant height (203.08cm), number of leaves plant^{-1} (10.18) and dry matter accumulation plant^{-1} (162.60 g) was recorded with treatment 150% RDN (N_3). At 60 DAS, 90 DAS and at harvest 150 % RDN (N_3) was significantly superior over 100% RDN (N_1) and was at par with 125% RDN (N_2) in all growth attributes. This might be due to higher dose of nitrogen increased the chlorophyll content which increased the cell division, cell elongation and rate of photosynthesis and extension of stem results in increased growth character. Panhwar *et al.* (2004), Dawadi and Sah (2012) [2] and Afridi *et al.* (2016) [1] reported that number of leaves plant^{-1} of maize increased with an increase in nitrogen levels.

Application of various nitrogen doses significantly affected the yield attributes viz. number of cobs plant^{-1}, weight of cobs plant^{-1}, weight of grains cob^{-1}, grain yield plant^{-1} (g) of maize. Data revealed in Table 1 that highest number of cobs plant^{-1} (1.26), weight of cobs plant^{-1} (177.75 g), weight of grains cob^{-1} (59.22 g) grain yield plant^{-1} (75.21 g) was recorded with 150% RDN (N_3) and was found significantly superior over 100% RDN (N_1) but which was at par with 125% RDN (N_2). Gosavi and Bhagat (2009) [3]. and Rashwan and Zen El-Dein (2017) [10] reported that number of cobs plant^{-1}, grain yield per fad, grain yield per ear, were increased with the increment in nitrogen level. Kumar *et al.*, (2017) [6] revealed that 100 per cent RDN recorded significantly higher cob length, number of grains per row, number of grains per cob, cob yield and grain yields per plant than 75 percent.

Interaction effect

Interaction effect between different planting pattern and nitrogen doses on growth attributes and yield attributes in maize + cowpea intercropping was found to be non-Significant.

Conclusion

Growth characters of maize *viz*. plant height, number of leaves plant^{-1}, dry matter accumulation plant^{-1} (g) and yield attributes and yield such as number of cobs plant^{-1}, weight of cobs plant^{-1}, weight of grains cob^{-1}, grain yield plant^{-1} (g) of maize was significantly higher with planting pattern of maize + cowpea 2:2 (P_4) and application of 150% RDN.

Table 1: Growth and yield attributes of maize as influenced by various treatments

Sr. No.	Treatments	Growth attributes			Yield attributes			
		Plant height cm	No. of leaves plant^{-1}	Mean dry matter accumulation plant^{-1} (g)	No. of cobs plant^{-1}	Wt. of cobs plant^{-1} (g)	Wt of grains cob^{-1} (g)	Grain yield plant^{-1} (g)
A	Planting pattern							
	P_1 : Sole maize	198.38	9.63	159.43	1.10	164.10	55.18	60.19
	P_2 : Maize + cowpea (1:1)	199.74	9.74	160.64	1.07	162.18	54.50	58.31
	P_3 : Maize + cowpea (2:1)	200.86	9.82	161.67	1.32	177.74	59.74	77.40
	P_4 :Maize + cowpea (2:2)	201.77	10.06	162.26	1.34	179.34	60.68	80.60
	SE (m) ±	0.27	0.07	0.33	0.01	1.75	0.27	0.66
	CD at 5%	0.81	0.22	0.99	0.04	5.25	0.81	1.98
B	Nitrogen dose							
	N_1: 100 % RDN	195.03	9.21	158.87	1.13	161.48	54.66	62.01
	N_2: 125% RDN	202.46	10.06	161.90	1.23	173.28	58.69	70.15
	N_3: 150% RDN	203.08	10.18	162.60	1.26	177.75	59.22	75.21
	SE (m) ±	0.24	0.06	0.29	0.01	1.52	0.24	0.57
	CD at 5%	0.71	0.19	0.87	0.03	4.56	0.72	1.71
AXB	Interaction							
	SE (m) ±	0.48	0.13	0.59	0.02	3.11	0.48	1.16
	CD at 5%	NS	NS	NS	NS	NS	NS	NS
	GM	200.2	9.81	161.12	1.21	170.84	57.52	69.12

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