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EFFECT OF INTERCROPPING AND NITROGEN MANAGEMENT ON GROWTH AND PHENOLOGY OF PIGEONPEA, SWEET CORN AND BABY CORN USING NANO UREA

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ABSTRACT

A field experiment was carried out during *kharif* 2021 and 2022 at Birsa Agricultural University Ranchi, to evaluate the phenological character of sweet corn and baby corn and plant growth of pigeon pea, sweet corn and baby corn as influenced by pigeon pea based intercropping system and nitrogen management. Plant height (cm), dry matter accumulation, numbers of nodules per plat and nodules weight (g/plant),days to 50% tasseling, days to 50 % silking, tasseling- silking interval, day to 1st picking, number of pickings and yield (kg/ha). Among the different intercropping systems and nitrogen management, mean data of 2021 and 2022 of plant growth, phenology and yield of sole pigeonpea, sole sweet corn and sole baby corn was noted higher over intercropping system. Among intercropping system maximum plant height (234.6, 166.1 cm) and dry matter accumulation (684.1, 1349.1 g/m^2) at harvest of pigeonpea and sweet corn and number of nodules per plant (25.7, 30.7), nodules weight (0.182 and 0.222 g/plant) at 30 and 60 DASof pigeon pea was found under pigeon pea + sweet corn intercropping over pigeonpea + baby corn intercropping system. Regarding nitrogen management 100 % RDN recorded maximum plant height (257.4, 192.8 cm) and dry matter accumulation (777.4, 1667.8 g/m^2) at harvest of pigeon pea and sweet corn and number of nodules per plant (28.4, 33.7), nodules weight (0.201 and 0.244 g/plant) at 30 and 60 DAS of pigeon pea. Whereas number of pickings was found equal (1.0) under all treatments of sweet cornand maximum under sole baby corn as well as in intercropping (3.0) with 100 % RDN. The lowest value of phonological parameters forsole sweet corn and baby corn with 100% RDN recorded lowest value over intercropping systems respectively. The maximum grain yield of pigeonpea (1486 kg/ha), cob yield of sweet corn (15310 kg/ha) and baby corn (8932 kg/ha) was found under sole condition. With respect to intercropping system maximum grain yield of pigeon pea was found (1361 kg/ha) under pigeonpea + sweet corn intercropping system over pigeonpea + baby corn (1292 kg/ha).

KEY WORDS : Pigeon pea-based Intercropping systems, Nano urea, 2% urea, Recommended dose of nitrogen (RDN), Specialized corn

INTRODUCTION

Pigeon pea (*Cajanus cajan* L. Mill-sp.) is a common pulse crop among Indian farmers, in part due to their aptitude for dryland environments and their adaptability to both pure and mixed/intercropping systems (Kumawat *et al*., 2017). The initial growth rate is very slow and deep root system of pigeonpea offers a good source for intercropping with fast growing, early maturing and shallow rooted crops (Ahamad *et al*., 2016). Is one of the most popular intercropping systems followed in India maize + pigeon pea (Mucheru *et al*., 2010). In pigeon pea based intercropping system sweet corn and baby

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corn can use maximum natural resources and adopted well in between pigeon pea. Maize (*Zea. mays*) is India's third-most important cereal cropafter rice and wheat (Anonymous, 2011). In general, maize may be grown successfully throughout the year and being a C_4 crop, it utilizes solar energy more efficiently than other cereals. The wide adaptability of maize makes to over-wide range of climatic conditions around the world (Amanullah *et al*., 2007 and Chennan *et al*., 2012). Itcontributes to more than 55% of non-meat calories consumed by humans globally, and its continuous production is essential for ensuring food security (Lobell *et al*., 2007). As a result, it is vital to monitor maize physiology and phenological growth conditions determining the productivity of maize. Crop heightis an important agronomic measure that can be utilized for estimating aboveground biomass and agricultural grain production (Eitel *et al*., 2016 and Xie *et al*., 2021). In way of specialised corn i.e., sweet corn (*Zea mays* L. *Saccharata*) is a type of maize and popular vegetable in the United States, Canada, and Australia. Now it is gaining popularity in India and other Asian countries due to its greater sugar content (13-20%), lower starch content, excellent flavour, and higher market value when compared to *Zea mays* green cobs (Sahoo *et al*., 2007). Baby corn is one such newly grown vegetable that is both tasty and nutritious and is consumed as a natural food, because it is a short-season crop, it can be produced and harvested three to four times per year (Pandey *et al*., 1998). Despite of the fact that these speciality corn generates high prices in both domestic and international markets, Indian farmers are unaware of its importance (Thavaprakaash *et al*., 2006). Nitrogen deficiency at any stage of maize crop growth may affect the growth and phonological character like plant height, tasseling and silking stages etc. of sweet corn and baby corn and can even leads to crop failure. However, choice ofmaize variety, soil type, fertility status of soil, crop growing location, and yield potential affect how much nitrogen should be supplied to a maize plant (Shrestha *et al*., 2018). Thus, the present study was carried out to evaluate the impact different nitrogen application level and pigeon pea based intercropping system on phenology and growth character of pigeon pea, sweet corn and baby corn.

MATERIALS AND METHODS

A field experiment was laid out in Split Plot Design (SPD) with three replications at Agronomy Research Farm, Ranchi Agriculture Collage, Birsa Agricultural University, Kanke, Ranchi, Jharkhand during the *Kharif season* of 2021 and 2022. The main plot treatments comprised of five crops combinations i.e., Sole pigeon pea, sole sweet corn, sole baby corn, pigeon pea + sweet corn and pigeon pea + baby corn. The sub-plot treatments have five nitrogen management practices such as 100% RDN (Recommended dose of nitrogen), 50% RDN, 50% RDN+ two spray of Nano urea (4ml/litter of water), 50% RDN + two spray of urea (2%) and Control i.e., N_5. The Pigeon pea, sweet corn and baby corn variety used was Birsa Arhar-1, Sugar-75 and BVM-2 respectively sown on 22nd June-2021 and 20th June-2022 at spacing of 60 cm×25 cm for pigeon pea and sweet corn and 60 cm×15 cm for baby corn in sole as well as with pigeon pea inter-cropping system. The recommended dose of fertilizer N: P_2O_5:K_2O was 25:50:25:20 for pigeon pea and 150:60:40 for sweet corn and baby corn. Plant height (cm), dry weight (g/m^2), numbers of nodules per plant, nodules weight (g/plant), Days to 50% tasseling, days to 50% silking, tasseling-silking interval, day to 1st picking, number of pickings and yield (kg/ha) were studied to judge crop performance.

RESULTS AND DISCUSSION

Plant height (cm)

Sole pigeon pea (C_1) recorded maximum plant height at harvest (Table 1) followed by intercropping systems pigeon pea + sweet corn and pigeon pea + baby corn. Similarly, sole sweet corn (C_2) and sole baby corn (C_3) recorded higher plant height as compared to their intercropping system i.e., C_4 and C_5respectively. Among nitrogen management, 100% recommended dose of nitrogen (N_1) registered maximum plant height at harvest followed by 50 % RDN + two sprays of Nano urea (4 ml/liter of water) >50 % RDN + two sprays of urea (2%)>50 % RDN, smallest plant height was recorded under control (N_5). Since sole crops experience less competition for light, nutrients and water than intercropping, which promoted faster growth of sole crop as compared to intercrops (Naik *et al*., 2012).

Dry weight (g/m^2)

Dry matter of pigeon pea, sweet corn and baby corn maximum at harvest when grown in sole stand as compared to their intercropping systems (Table 1). Among nitrogen management, the application of

full recommended dose of nitrogen registered maximum dry weight at harvest followed by $N_3 > N_4 > N_2 > N_5$. The sole pigeon pea, sweet corn, and baby corn face less competition for moisture, nutrients and light, that's why crops grown in sole stand have higher growth and more photosynthetic rate promoting better metabolic activities, which results in increased cell division and metabolic tissues, and ultimately more dry matter production (Pal *et al*., 2016; Singh and Abraham 2017 and Yadav *et al*., 2021).

Number of nodules and weight of nodules (g)

On the basis of two-year mean data, sole pigeon pea (C_1) had a higher number of nodules and weight of nodules per plant at 30 and 60 DAS than pigeon pea intercropping systems with sweet corn or baby corn. Among intercropping systems, pigeon pea intercropped with sweet corn recorded maximum number of nodules and weight of nodules per plant over pigeon pea + baby corn intercropping system. In case of nitrogen management, the number of nodules and weight of nodules per plant were recorded higher with 100% RDN application as compared to other nitrogen management practices. The lowest number of nodules and weight of nodules per plant were seen when no nitrogen was applied, i.e., control (Table 1). Intercropping increases competition for nutrients, water, and space (Pal *et al*., 2016 and Yadav *et al*., 2021) resulting in poorer values.

Days to 50% tasseling and days to 50% silking

Mean results from 2021 and 2022 reveled that the days to 50% tasseling and days to 50% silking of sweet corn and baby corn was observed earlier under sole condition over pigeon pea + sweet corn and pigeon pea + baby corn intercropping system respectively (Table 2). Similarly, application of 100% RDN reduces the vegetative stage of sweet corn and baby corn thereby reduces the days to 50% tasseling and 50% silking of sweet corn and baby corn in comparison of other nitrogen management practices. Earlier studies made by (Rai, 1961 and Yadav, 1990) also reported that increasing the rate of nitrogen application caused earliness in all

Table 1. Plant height, dry weight, number of nodules per plant and weight of nodules per plants (g) of component crops at harvest as influence by pigeon pea based intercropping system through nitrogen management (mean of 2021 and 2022).

	At harvest		Number of nodules per plant		Weight of nodules per plants (g)	
	Plant height (cm)	Dry weight (g/m^2)	30 DAS	60 DAS	30 DAS	60 DAS
Crop						
Sole pigeon pea (C_1)	240.3	756.5	26.8	32.2	0.187	0.234
Sole sweet corn (C_2)	172.4	1496.7	-	-	-	-
Sole baby corn (C_3)	164.9	1632	-	-	-	-
Pigeon pea + sweet corn (C_4)	234.6 (166.1)	684.1 (1349.1)	25.7	30.7	0.182	0.222
Pigeon pea + baby corn (C_5)	231.3 (148.2)	635.5 (1525.0)	23.3	28.9	0.163	0.210
Nitrogen management						

	PP	SC	BC	PP	SC	BC	PP	PP	PP	PP
100 % RDN (N_1)	257.4	192.8	180.8	777.4	1667.8	1815.4	28.4	33.7	0.201	0.244
50 % RDN (N_2)	229.7	162.8	155.5	673.1	1392.4	1569.5	26.5	29.6	0.185	0.215
50 % RDN + two spray of Nano urea (4ml/l of water) at 30 and 50 DAS (N_3)	253.9	189.4	176.9	757.6	1583.8	1700.5	26.2	33.0	0.182	0.239
50% RDN + two spray of urea (2%) at 30 and 50 DAS (N_4)	249.6	178.2	163.7	726.4	1480.5	1601.5	26.4	32.4	0.184	0.235
Control (N_5) i.e., no nitrogen	186.4	123.2	105.8	525.7	990.0	1205.4	17.9	24.4	0.124	0.178

Note- Figure in parenthesis is represent the value of SC and BC

Note-PP- pigeon pea, SC-Sweet corn and BC- Baby corn. Figure in parenthesis is represent the value of SC and BC

N_1=100% RDN, N_2=50%RDN, N_3= (50% RDN + two spray of Nano-urea (4ml/l) at 30 and 50 DAS), N_4= (50% RDN + two spray of urea (2%) at 30 and 50 DAS) and N_5=(Control)

Note- PP- pigeon pea (90-at harvest), SC-Sweet corn and BC- Baby corn (60-at harvest respectively). Figure in parenthesis is represent the value of SC and BC

phonological parameters except number of pickings.

Tasseling-silking interval and day to 1st picking

The mean results showed that sole sweet corn and baby corn with 100% RDN application shortened tasseling-silking interval and reduces day to 1st picking over pigeon pea + sweet corn and pigeon pea + baby corn intercropping system (Table 2). The increasing nitrogen level reduces the vegetative and reproductive stages internal of corn due to better growth and maximum utilization of photosynthates resulting, reduction in tasseling-silking interval and day to 1st picking (Shrestha *et al*., 2018).

Number of pickings

Similar number of pickings was recorded under sole sweet corn in all treatments however sole baby corn noted higher number of pickings over pigeon pea + baby corn intercropping system (Table 2). Among nitrogen management, 100% RDN and 50 % RDN + two sprays of Nano urea (4ml/liter of water) was recorded maximum number of pickings followed by $N_4 > N_2 > N_5$.

Yield (kg/ha)

Mean data of two years reveled that sole pigeonpea, sweet corn and baby corn recorded maximum grain yield and cob yield over intercropping systems (Table 2) while among intercropping system the pigeon pea + sweet corn recorded maximum grain yield of pigeon pea as compared to pigeon pea + baby corn. The higher plant population and early growth habit of baby corn leads to more competition for nutrients, water, space and light interception etc. resulting in lowering down the yield of pigeon pea. The sweet corn yield was also recorded higher than baby corn yield, grown as sole or in intercropping system due to prolong growth period of sweet corn in comparison to baby corn favoring higher photosynthates accumulation by the plants. Similarly, 100 % RDN application also recorded higher yield of pigeon pea, sweet corn and baby corn as compared to rest of the nitrogen management practices. minimum grain and cob yield was recorded with N_5, i.e., no nitrogen, due to less plant population in pigeonpea + sweet corn intercropping over pigeonpea + baby corn intercropping. This might be due to application of recommended dose of nitrogen fulfil the nutrient requirement of the crops resulting in their better growth and development and ultimately the yield (Rathod *et al*., 2004).

Table 2. Phenology of sweet corn and baby corn as influence by pigeon pea based intercropping system through nitrogen management (mean of 2021 and 2022).

	Day to 50% tasseling		Day to 50 % sliking		Tasseling-Silking interval		Day to 1st picking		Number of pickings		Yield (kg/ha)	
Crop												
Sole pigeon pea (C_1)	-		-		-		-		-		1315	
Sole sweet corn (C_2)	53.7		58		4.4		80.1		1.0		12059	
Sole baby corn (C_3)	47.3		51.8		4.5		52.5		2.5		6971	
Pigeon pea + sweet corn (C_4)	55.2		60.1		4.9		82.2		1.0		1182 (10995)	
Pigeon pea + baby corn (C_5)	47.6		52.3		4.7		52.8		2.4		1098 (6484)	
Nitrogen management												
	SC	BC	SC	BC	SC	BC	SC	BC	SC	BC	PP	SC	BC
100 % RDN (N_1)	53.2	45.3	57.0	49.2	3.8	3.8	79.1	49.8	1.0	3.0	1380	14552	8531
50 % RDN (N_2)	54.7	47.5	59.8	52.4	5.1	4.9	81.9	53.0	1.0	2.2	1105	11389	6716
50 % RDN + two spray of Nano urea (4 ml/l of water) at 30 and 50 DAS (N_3)	53.5	46.3	57.7	50.6	4.2	4.3	79.7	51.3	1.0	3.0	1367	13629	7931
50% RDN + two spray of urea (2%) at 30 and 50 DAS (N_4)	54.2	46.8	58.9	51.5	4.8	4.7	81.0	51.9	1.0	2.6	1301	12504	7341
Control (N_5) i.e., no nitrogen	56.7	51.3	62.0	56.7	5.3	5.3	84.1	57.2	1.0	1.5	840	5561	3120

Note- Figure in parenthesis is represent the value of SC and BC

CONCLUSION

Based on two years of experimentation it can be concluded that the pigeon pea + sweet corn intercropping system along with application of 100% RDN is beneficial to achieve higher pigeon pea and sweet corn productivity from that area.

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