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Evaluation of maize based inter cropping system as influenced by planting geometry and weed management practices

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ASTRACT

A field experiment was conducted during kharif seasons of 2016 and 2017 at the Research Farm, ICAR Research Complex for NEH Region, Nagaland Centre to study of the effect of planting geometry and weed management practices on maize (Zea mays L.) based intercropping system. The experiment was laid out in randomized block design with twelve treatments and replicated three times. The results revealed that different planting geometry patterns did not affect the growth and yield attributes at any stage of growth of maize. Growth attributes tended to increase with advancement of growth and maximum values were recorded at 90 DAS. The highest grain and stover yields of maize were recorded as 2.54 t ha^{-1} and 4.98 t ha^{-1} from the maize + soybean (2:2) planting geometry. Weed management practices had significant effect over weedy check on plant growth parameters, yield attributes, grain and stover yields except test weight of maize. The highest grain (2.87 t ha^{-1}) and stover yields (5.55 t ha^{-1}) of maize were recorded with two hand weedings at 20 and 40 DAS which was at par with pre-emergence application of pendimethalin @ 1.0 kg a.i.ha^{-1} + 1 HW at 30 DAS.

Keywords: Maize, planting geometry, weed management, yield

INTRODUCTION

Maize (*Zea mays* L.) is one of the most versatile 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 the cereals. In India, maize is the third most important food crop after rice and wheat. It is used as human food (23%), poultry feed (51 %), animal feed (12 %), industrial (starch) products (12%), beverages and seed (1 % each). Intercropping of cereals with legumes has been popular in rainfed areas (Dhima *et al.,* 2007) due to its advantages for soil moisture conservation, weed control (Banik *et al.*, 2006), lodging resistance and yield increase. Maize-legume intercropping system, besides increasing productivity and profitability also improves soil health, conserves soil moisture and increases total out turn (Padhi and Panigrahi, 2006; Singh *et al.*, 2008). Weed management in intercropping system needs concentrated scientific efforts to provide weed free environment to both the crop components. Wider row spacing in maize can be used to grow short duration legumes which will not only act as smoother crop, but also will give additional yield. Weed control approach involving intercropping, herbicides and non- chemical methods in maize and maize based intercropping system is very important to provide effective and acceptable weed control for realizing higher production (Shah *et al.*, 2011). Hence, maize is a good candidate of intercropping under rainfed agriculture as its demand and requirement increases in N.E.H. Region particularly in Nagaland. Among the *kharif* legumes, the probable legume crops which may be tried in maize-legume intercropping system under rainfed agriculture of Nagaland are black gram and soybean. However, the studies investigating the impact of planting geometry and weed management practices in maize based intercropping system remain scarce in Nagaland. The present study was, therefore, planned using maize based intercropping system.

MATERIALS AND METHODS

The field experiment was conducted at the Experimental Research Farm of ICAR Research Complex for NEH Region, Nagaland Centre, Medziphema during *kharif* season of 2016 and 2017 under rainfed conditions. The experimental field was well drained, sandy loam

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in texture with pH 4.5, 3.4 g kg^{-1} organic carbon and available N, P, and K 220, 21.1 and 224 kg ha^{-1}, respectively. The treatments consisted of four planting geometry *i.e.* maize + black gram (1:1), maize + black gram (2:2), maize + soybean (1:1) and maize + soybean (2:2) and three weed management practices *i.e.* weedy check, pre-emergence application of pendimethalin @ 1.0 kg a.i.ha^{-1} + 1 HW (Hand weeding) at 30 DAS (Days after sowing) and two hand weeding at 20 and 40 DAS. The experiment was laid out in the randomized block design with two factors (planting geometry and weed management) comprising twelve treatment combinations and replicated three times. The crops (maize, black gram and soybean) were sown in 1st week of June during both the seasons. The recommended dose of fertilizers 100:60:40 N P K kg ha^{-1} was applied at the time of sowing. All standard packages of practices were adopted for growing a good crop. Observation on growth parameters of maize *viz*., plant height, number of leaves $plant^{-1}$, leaf area index and stem diameter at 30, 60 and 90 DAS were recorded. At harvest, yield attributes, grain and stover yields of crop were recorded. The data obtained were subjected to statistical analysis as outlined by Gomez & Gomez (1984). The treatment differences were tested by using "F" test and critical differences (at 5 % probability).

RESULTS AND DISCUSSION

Growth characters

The growth parameters of maize at 30, 60 and 90 DAS, *viz*. plant height, number of leaves $plant^{-1}$, leaf area index and stem diameter were not significantly influenced by different planting geometry. The values of these growth characters tended to increase with advancement age of crop, irrespective of various treatments. The maximum values of these characters were recorded at 90 DAS. All the weed management practices had significant effect on plant growth parameters of maize *viz*. plant height, number of leaves $plant^{-1}$, leaf area index and stem diameter at 30, 60 and 90 DAS. Among the weed management practices, higher value of plant growth parameters of maize at 30, 60 and 90 DAS were recorded by two hand weeding at 20 and 40 DAS followed by pre-emergence application of pendimethalin @ 1.0 kg a.i.ha^{-1} + 1 HW 30 DAS. Rao *et al.* (2016) also reported that hand weeding at 20 and 40 DAS recorded the highest plant height. Rani and Sagar (2013) observed that taller plant and higher leaf area index was noticed with hand weeding twice at 20 and 40 DAS. This might be due to proper weed management treatments which resulted into less weed competition for nutrients, sunlight, space and water. The lowest plant height, number of leaves $plant^{-1}$, leaf area index and stem diameter in weedy check might be due to more competition between crop and weed for moisture, nutrients, light and space. Similar findings were also reported by Kamani *et al.* (2019).

Yield attribute and yield

The yield attributing characters of maize *viz*. number of cobs $plant^{-1}$, number of grain row cob^{-1}, number of grains row^{-1} and test weight were not affected significantly by different planting geometry. The weed management had significantly beneficial effect on yield attributing characters of maize *viz*. number of cobs $plant^{-1}$, number of grain rows cob^{-1} and number of grains row^{-1} over the weedy check. However, weed management practices did not affect significantly the test weight of maize. Among the weed management practices, the highest number of cobs $plant^{-1}$ (1.28), number of grain row cob^{-1} (12.24) and number of grains row^{-1} (29.5) of maize were recorded with two hand weeding at 20 and 40 DAS which was at par with pre-emergence application of pendimethalin @ 1.0 kg a.i.ha^{-1} + 1 HW 30 DAS. Sanodiya *et al.* (2013) noted higher yield attributes in hand weeding at 20 and 40 DAS. Hawaldar and Agasimani (2012) found that among the weed management practices weed free proved superior in respect to yield attributes. The probable reason for the highest yield attributing characters of maize under two hand weeding at 20 and 40 DAS might be due to better weed suppression up to minimum level thereby reducing crop weed competition at critical growth stages of the crop. Similar results were also reported by Haque *et al.* (2016).

Table 1: Effect of planting geometry and weed management practices on growth parameters of maize (pooled data of two years)

Treatments	Plant height (cm)			Leaves plant^{-1}			Leaf area index			Stem diameter (cm)		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
Planting geometry												
Maize + black gram (1:1)	52.1	175.7	208.4	8.6	12.9	13.4	1.19	3.22	3.32	1.32	1.62	1.72
Maize + black gram (2:2)	54.1	179.1	214.2	8.8	13.1	13.6	1.24	3.32	3.43	1.35	1.65	1.75
Maize + soybean (1:1)	53.2	177.6	211.8	8.7	13.0	13.5	1.21	3.27	3.38	1.33	1.64	1.74
Maize + soybean (2:2)	55.2	181.1	217.6	8.9	13.2	13.7	1.25	3.38	3.49	1.36	1.67	1.77
SEm±	1.61	3.88	5.27	0.20	0.32	0.35	0.04	0.17	0.18	0.04	0.04	0.04
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Weed management (W)												
W_0	48.4	164.0	195.0	8.1	11.9	12.4	1.11	2.64	2.72	1.21	1.50	1.60
W_1	55.8	184.6	220.1	9.0	13.3	13.8	1.27	3.58	3.69	1.40	1.71	1.80
W_2	56.7	186.6	223.9	9.2	13.8	14.5	1.29	3.67	3.82	1.41	1.72	1.83
SEm±	1.39	3.36	4.57	0.17	0.28	0.31	0.03	0.15	0.15	0.03	0.04	0.04
CD (P=0.05)	3.97	9.57	13.02	0.48	0.79	0.87	0.09	0.43	0.44	0.09	0.10	0.10

DAS: days after sowing; HW: hand weeding; NS: non significant, W_0: Weedy check, W_1: pre-emergence application of pendimethalin @ 1.0 kg a.i.ha^{-1} + 1 HW at 30 DAS, W_2: two hand weeding at 20 and 40 DAS

Grain and stover yields of maize differed significantly with planting geometry and weed management practices. The highest grain and stover yields of maize were recorded as 2.54 t ha^{-1} and 4.98 t ha^{-1} from maize + soybean (2:2) followed by maize + black gram (2:2) as 2.48 t ha^{-1} and 4.89 t ha^{-1} respectively. The reason for maximum grain yield in paired row planting may be due to decreased competition between plants because of equivalent spatial arrangement of plants. Similar findings were also reported by Kithan and Longkumer (2016). The minimum grain (2.38 t ha^{-1}) and stover (4.73 t ha^{-1}) yields were recorded under maize + black gram (1:1) intercropping system. The weed management practices had significant effect on grain and stover yield of maize over the weedy check. The highest grain (2.87 t ha^{-1}) and stover (5.55 t ha^{-1}) yields of maize were recorded by two hand weeding at 20 and 40 DAS which was at par with pre-emergence application of pendimethalin @ 1.0 kg a.i.ha^{-1} + 1 HW at 30 DAS. The increases in grain and stover yield of maize with two hand weedings at 20 and 40 DAS were 69.8 and 55.4% over weedy check, respectively. Subbulakshmi *et al.* (2009) reported that highest grain and stover yield were recorded by hand weeding on 20 and 40 DAS. Similar results were also reported by Sanodiya *et al.* (2013). The increased grain and stover yields may be the result of better weed control which gave favourable conditions like increased availability of nutrients, moisture, light, etc. The lowest grain yield was recorded under weedy check. The grain yield of maize was severely reduced due to more crop weed competition. Similar result was also reported by Dwivedi and Shrivastava (2011). Reduction in grain yield was caused by reduced growth and yield components of maize under increased pressure of weed competition for space, light, nutrients etc. (Haque *et al.*, 2013).

Table 2: Effect of planting geometry and weed management practices on yield attributes and yield of maize (pooled data of two years)

Treatments	Cobs plant^{-1}	Grain rows cob^{-1}	Grains row^{-1}	Test weight (g)	Grain yield (t ha^{-1})	Stover yield (t ha^{-1})
Planting geometry						
Maize + black gram (1:1)	1.13	11.60	28.4	232.2	2.38	4.73
Maize + black gram (2:2)	1.23	11.98	28.7	233.0	2.48	4.88
Maize + soybean (1:1)	1.16	11.79	28.6	232.5	2.43	4.82
Maize + soybean (2:2)	1.26	12.13	28.9	233.2	2.54	4.98
SEm±	0.07	0.34	0.41	1.40	0.14	0.28
CD (P=0.05)	NS	NS	NS	NS	0.40	0.81
Weed management (W)						
W_0	1.0	10.81	27.2	231.2	1.69	3.57
W_1	1.28	12.24	29.1	233.2	2.79	5.44
W_2	1.32	12.58	29.5	233.7	2.87	5.55
SEm±	0.06	0.29	0.36	1.21	0.12	0.25
CD (P=0.05)	0.18	0.83	1.02	NS	0.35	0.71

It may be concluded from the results that among the planting geometry, 2:2 planting geometry of maize + soybean and maize + black gram gave the maximum grain yield and stover yield of maize. Hence, in maize based intercropping system with soybean or black gram, 2:2 planting geometry proved more superior under the rainfed conditions for maximum grain and stover yields. Among the weed management practices, two hand weeding at 20 and 40 DAS and pre-emergence application of pendimethalin @ 1.0 kg a.i.ha^{-1} + 1 HW at 30 DAS were equally effective in increasing plant growth parameters and yield attributes, grain and stover yields of maize.

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