Forage Res., **43** (4) : pp. 270-273 (2018) **http://forageresearch.in**

EFFECT OF PLANTING DATES AND SEED RATES ON PERFORMANCE OF FODDER MAIZE (*ZEA MAYS*) UNDER RAINFED CONDITION OF MANIPUR

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(Received : 2 November 2017; Accepted : 5 March 2018)

SUMMARY

In order to study the effect of sowing date and seed rate on morphological traits and forage yield. An experiment was carried out in the Experimental Research Farm, Andro, Central Agricultural University, Imphal during ***kharif*** season of 2012, 2013 and 2014, based on a Factoral Randomized Block design with three replications. The treatments consist of three different date of sowing (26th May, 4th June, and 14th June) and seed rate (40 kg/ha, 60 kg/ha and 80 kg/ha); and the combination of both. The results showed that delay in sowing from May 26th decreased significantly in green fodder yield, dry matter yield, crude protein yield and plant height respectively. With increasing seed rate from 40 to 80 kg/ha, dry matter yield and crude protein yield decreased, but plant height increased. According to the results, the treatment of sowing date of May 26 with seed rate of 60 kg /ha recommended for the cultivation of forage maize under the rainfed condition of Manipur.

Key words : Forage maize, rainfed, seed rate, sowing date, yield

Maize (Zea mays L.) is the world, most widely grown cereal and it is ranked third among major cereal crops. Maize has a big potential in that it has a large utilization as food sources for people and animals and for industry. Sowing date and plant density are very important parameters in crop production. The optimum sowing date and seed rate paves the way for better-use of time, light, temperature, precipitation and other factors. Planting date is critical in cold climates due to the potential for frost damage in late of season (Johnson *et al*., 1995). Kresovic *et al*. (1997) in sweet corn reported that delay in sowing from June 21 to July 11 decreased total yield of corn as second crop. There is an optimum plant density for each crop. Also, it is possible that under low plant density, although single-plant production increased, yield per unit area decreases (Ghanbari and Taheri Mazandarani, 2003). On one hand, plant deficit per unit area prevents maximum usage of production parameters and on the other hand, excessive density can increase the competition and decrease the yield. Plant density is of particular importance in maize, because it does not have tillering capacity to adjust to variation in plant stand. Cox and Cherney (2001) reported that increasing plant density increased dry matter (DM) yield of corn. Bangarwa *et al*. (1988) stated that generally, the yield of a single maize plant decreases with increasing plant population whereas the yield per unit area increases. Also, and Karlen *et al*. (1985) reported that total dry matter increases 6 to 40% when plant density increases from about 55000 to 88000 plants/ha. Edwards *et al*. (2005) reported dry matter accumulation increase for corn hybrids at high than at low density due to light interception. Yarnia (2010) reported that interaction between delay sowing and increasing plant density decreased leaf area of amaranth at least 19.63 up to 97.15%. Safari1 *et al*. (2008) in a study to determine the best planting date and plant density on forage yield of foxtail millet stated that forage yield increased with increasing plant density. The highest forage yield obtained in 60 plants/m^2 and forage yield decreased with delaying of planting date, as highest density forage yield obtained in first planting date. Also, total dry matter and leaf

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area index increased with increasing plant density but decreased with delay in planting date. Therefore, this research was carried out to evaluate the effect of different seed rate and planting dates on performance of fodder maize (*Zea mays*) under rainfed condition of Manipur, India.

MATERIALS AND METHODS

The field experiment was conducted during kharif seasons of 2012, 2013 and 2014 at the Central Agricultural University, Imphal where kharif crop was raised under rainfed condition to assess the forage yields of maize under various dates of sowing and seed rate. The experiment was laid out in FRBD with three replications and nine treatments. The treatments consist of three different date of sowing (26th May, 4th June and 14th June) and seed rate (40 kg/ha, 60 kg/ha and 80 kg/ha); and the combination of both. The Farm is situated at about latitude of 24^{o}.4589" N and longitude of 94^{o}.0346" E with an altitude of 875 meters above mean sea level. The soil of the experimental field was clayey in texture. The experiment was conducted in a sub-tropical climate where monsoon normally begins from June and extends up to September and retreats from October onward. Agro-meteorological data of 2012, 2013 and 2014 presented in Fig. 1, 2and 3, respectively.

According to the results of soil test, 80 kg/ha urea and 40 kg/ha ssp was applied to the soil before final disking. Having disinfected by fungicide carboxin thiram with the ratio of 2:1000, the seeds were dry-sown at the depth of 3-4 cm. The desired plant densities were created by changing the spacing between plants at the emergence of the three leaves. Half of nitrogen along with full dose of phosphorous was applied at the time of sowing, while remaining half of nitrogen was applied at knee height. The nitrogen and phosphorous was applied in the form of urea and ssp. All other agronomic practices were kept uniform for all the treatments. Weeds were controlled manually. The crop was harvested at 50 % flowering stage and following observations were recorded during the course of study: Plant height (cm), Leaf stem ratio, dry matter yield (q/ha), green forage yield (t/ha), crude protein content(%) and crude protein yield (q/ha) by using the standard methods. The data collected were statistically analyzed using Fisher's analysis of variance technique and the treatment means were compared by least significant difference (LSD) test at 0.05 level of probability. (Steel *et al*., 1997).

RESULTS AND DISCUSSION

The results showed that green fodder yield, dry matter yield and crude protein yield of forage maize were significantly affected by sowing date and seed rate but crude protein content, plant height and leaf stem ratio were found insignificant. Sowing date and seed rate interaction were also found significant on morphology traits.

Pool data comparison indicated that with the delay in sowing, green fodder yield was decreased by 17.3 and 35% at the sowing dates of June 4 and June 14 as compared with the sowing date of May 26, respectively (Table 1). The significant decrease

TABLE 1
Effect of sowing date and seed rate on performance of fodder maize

Treatment	Sub-class	Green fodder yield (q/ha)				Crude protein (%)				Crude protein yield (q/ha)			
		2012	2013	2014	Pooled	2012	2013	2014	Pooled	2012	2013	2014	Pooled
Sowing date	26th May	394.89	505.18	501.25	495.74	6.46	9.41	8.20	7.94	8.01	15.35	10.26	10.91
	4th June	434.00	376.78	390.10	409.96	6.88	9.70	7.09	7.95	7.31	11.66	7.00	8.73
	14th June	385.56	349.78	346.47	322.31	6.81	8.05	7.02	7.31	7.10	6.29	5.63	6.08
SEm+		4.97	3.13	2.65	2.21	0.23	0.59	0.32	0.25	0.56	0.77	0.44	0.36
CD at 5%		14.89	9.38	7.95	6.64	NS	NS	NS	NS	1.67	2.31	1.32	1.09
Seed rate (kg)	40	480.22	410.00	405.74	403.36	6.93	10.19	7.37	8.19	9.18	14.83	7.58	10.39
	60	463.55	404.29	407.96	415.60	6.40	8.30	7.72	7.45	7.54	10.45	7.86	8.26
	80	270.67	417.45	424.13	409.04	6.82	8.67	7.22	7.57	5.70	8.03	7.45	7.08
SEm+		4.97	3.13	2.65	2.21	0.23	0.59	0.32	0.25	0.56	0.77	0.44	0.36
CD at 5%		14.89	9.38	7.95	6.64	NS	NS	NS	NS	NS	2.31	1.32	1.09
Interaction: DXS													
SEm+		8.60	5.96	4.59	3.83	0.40	1.02	0.55	0.43	0.97	1.33	0.76	0.63
CD at 5%		25.78	17.86	13.76	11.49	NS	NS	NS	NS	NS	4.00	NS	1.88

TABLE 2
Effect of sowing date and seed rate on performance of fodder maize

Treatment	Sub-class	Plant height (cm)				Dry matter yield (q/ha)				Leaf stem ratio			
		2012	2013	2014	Pooled	2012	2013	2014	Pooled	2012	2013	2014	Pooled
Sowing date	26th May												
219.26	263.95	264.93	249.38	118.58	161.21	124.79	139.56	0.49	0.70	0.72	0.64		
	4th June	177.67	236.82	235.63	216.71	111.80	118.58	99.54	112.01	0.57	0.58	0.60	0.58
	14th June	83.22	224.56	224.96	177.55	103.75	79.88	80.16	81.20	0.64	0.71	0.62	0.66
SEm+		15.77	1.55	1.96	5.26	6.12	4.00	2.60	2.85	0.06	0.05	0.02	0.03
CD at 5%		47.27	4.63	5.86	15.78	18.34	11.98	7.79	8.54	NS	NS	NS	NS
Seed rate (kg)	40	136.67	247.80	246.15	210.17	138.06	139.11	101.93	122.88	0.65	0.62	0.61	0.63
	60	197.44	243.80	247.78	229.68	112.41	126.42	100.38	111.98	0.56	0.63	0.64	0.61
	80	146.04	233.73	231.59	203.79	83.65	94.15	102.18	97.91	0.50	0.75	0.68	0.64
SEm+		15.77	1.55	1.96	5.26	6.12	4.00	2.60	2.85	0.06	0.05	0.02	0.03
CD at 5%		47.27	4.63	5.86	15.78	NS	11.98	7.79	8.54	NS	NS	0.07	NS
Interaction: DXS													
SEm+		27.31	2.68	3.39	9.12	10.60	6.92	4.50	4.93	0.11	0.09	0.04	0.06
CD at 5%		NS	8.03	10.16	NS	NS	20.75	13.50	14.79	NS	NS	NS	NS

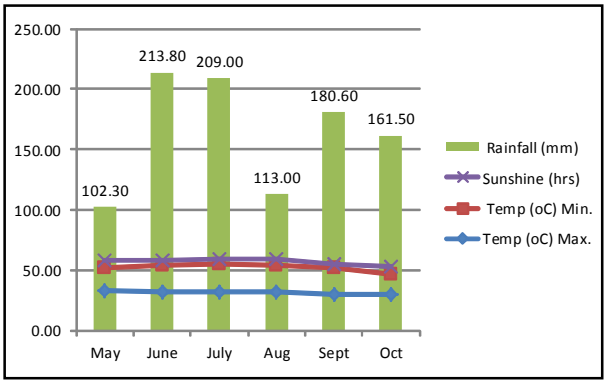

Fig. 1. Agro-metrological data of 2012 during the growing period.

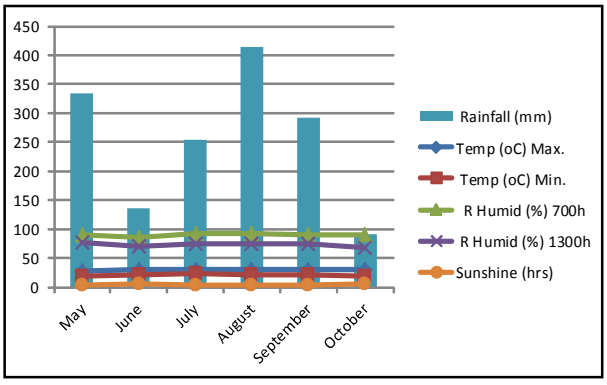

Fig. 2. Agro-metrological data of 2013 during the growing period.

in green fodder yield and plant height following the delay in sowing can be associated with higher

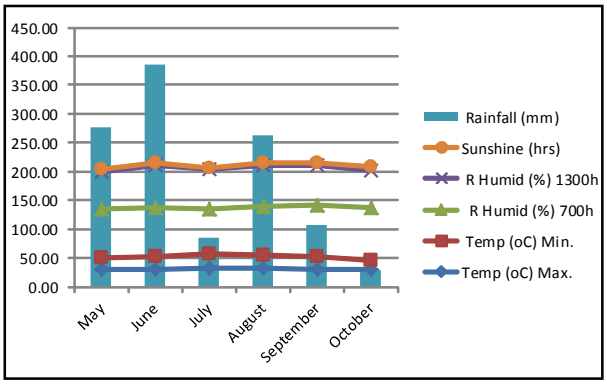

Fig. 3. Agro-metrological data of 2014 during the growing period.

temperatures that the plants at the second and third sowing dates experienced which limited their growing period and assimilate-building because of the early maturity of plants. Thus, the plants did not have adequate opportunity for photosynthesis and their height and fodder yielding capacity decreased. These results are in agreement with the results of Jafari (2010) on forage millet. Morin and Dormency (1993) reported that delay of sowing caused a decline in plant height which are agreement with results of this study. Pool data comparison showed that increase in seed rate upto 60 kg/ha increased green fodder yield and plant height by 3 and 9%. But further increase in seed rate from 60 kg/ha to 80 kg/ha, decreased in fodder yield and plant height by 2 and 11% respectively (Table 1 and 2). The results also

TABLE 3
Interaction effect of sowing date and seed rate on performance of fodder maize

Sowing date	Pooled Green fodder yield (q/ha)				Pooled Net return (Rs./ha)			
	Seed rate (kg/ha)							
	40	60	80	Mean	40	60	80	Mean
26th May	474.54	526.74	485.93	495.74	55011	62618	56275	57968
4th June	426.18	376.57	427.13	409.96	47313	39649	47010	44658
14th June	309.35	343.50	314.07	322.31	29343	34244	29608	31065
Mean	403.36	415.60	409.04		43889	45504	44298	
	Date of sowing	Seed rate	Date of sowing x Seed rate		Date of sowing	Seed rate	Date of sowing x Seed rate	
SEm+	2.21	2.21	3.83		332	332	575	
CD at 5%	6.64	6.64	11.49		995	995	1724	

showed that change in sowing date and seed rate significantly affected dry matter yield and crude protein yield. Means comparison revealed that delay in sowing from May 26 to June 14 decreased total dry yield and crude protein by 41.8 and 44.2%, respectively (Table 1 and 2). And also dry matter increased with the increase in seed rate. These finding are in agreement with those of Egli and Guffy (1997). The increase in total dry matter with the increasing of plant population indicates the favourable response of biomass produced corn to plant population. In economics point of view, maize sown on 26th May with a seed rate of 60 kg/ha gives maximum net return (Table 3).

CONCLUSION

In total, given the results of the study, early sowing of forage maize in May 26 can be recommended for the cultivation of forage corn in Manipur, because plants have longer growth period, their growth and development coincides with favourable environmental conditions, they produce stronger vegetative parts and more assimilates. Also, seed rate (60 kg/ha) can be recommended because of the increase in usage of radiation and other inputs for the production of biomass per hectare.

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