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Performance of Pre-*kharif* Maize under different Sowing Windows and Inter-Cropping with Green Gram

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ABSTRACT: A field experiment was conducted at the Research Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal, India during the pre-*kharif* season *i.e.* 3rd week of January to 2nd week of June for the year 2017 and 2018in order to study the performance of maize under different sowing dates and spatial arrangements with green gram. The experiment was laid out in split plot design having five main-plot treatments as sowing dates *i.e.* 17th January (3rd meteorological week), 24th January (4th meteorological week), 31st January (5th meteorological week), 7th February (6th meteorological week) and 14th February (7th meteorological week); and three sub-plot treatments (cropping systems) *i.e.* sole maize, maize + green gram (1:1) and maize + green gram (1:2) with three replications. Results from the experiment revealed that, different sowing dates were determining factors for growth attributes such as plant height, dry matter accumulation and leaf area index. Sole maize crop recorded the highest value of dry matter accumulation at 30 and 50 DAS when sown on February 14th, while 5th meteorological week *i.e.* 31st January-sown sole maize crop accumulated its highest dry matter at 70 DAS, 90 DAS and at harvest. February 7th planted maize recorded higher value of cob length, number of seeds row^{-1}, grain weight cob^{-1}and grain yield for both the years.

Keywords: Maize, inter-cropping, green gram, sowing date.

INTRODUCTION

Maize (*Zea mays* L.) is one of the most significantly emerging, multifaceted crops with spacious adaptability to conglomerate agro-climatic conditions and to grow under adverse climatic conditions and ecologies (Ramachandiran and Pazhanivelan 2016). It is successfully grown from 500 m to more than 3000 m above mean sea level under a wide range of moisture level i.e. from irrigated to semi-arid conditions. Globally, it has obtained commanding role in the farming sector and in the macro-economy of Asia. Maize is known as 'Queen of cereals' for its highest yield potential among the cereals. This crop also has the highest potential of per day carbohydrate productivity. Maize stands third among important food crops of India after rice and wheat. In India, the crop is cultivated in an average area of 9.21 million ha with an average production and productivity of 25.1million tones and 2727 kg ha^{-1} respectively during the time span of 2013-14 to 2017-18 (DoES, 2020). The projected demand of maize is 45 million tonnes to meet its requirement for human consumption, pharma industry, and supply of feed and fodder for cattle, poultry and piggery by 2030 (Kumar *et al*., 2013). Greengram (*Vigna radiate* L.) is an important pulse crop that contains high quality protein and satisfactory amounts of minerals and vitamins. It has the potential to endow on a large scale to the pulse production in India. Greengram being a short stature legume crop with short duration and fast growing in nature can find place in many intercropping systems. One or two rows of green gram can profitably be raised between two rows of maize. Considering the ever-increasing demand for pulses, the country's pulse production needs to be uplifted with concerted efforts. This can be achieved either by expansion of more area under pulses or by enhancing the productivity per unit area or by intercropping. Efficient practice to exploit the available inter-row space which gets occupied by weed in conventional method also enhances the production per unit area and improves the fertility of soil for successive crop production. Moreover, there exists least chance of total crop loss by biotic/abiotic factors.

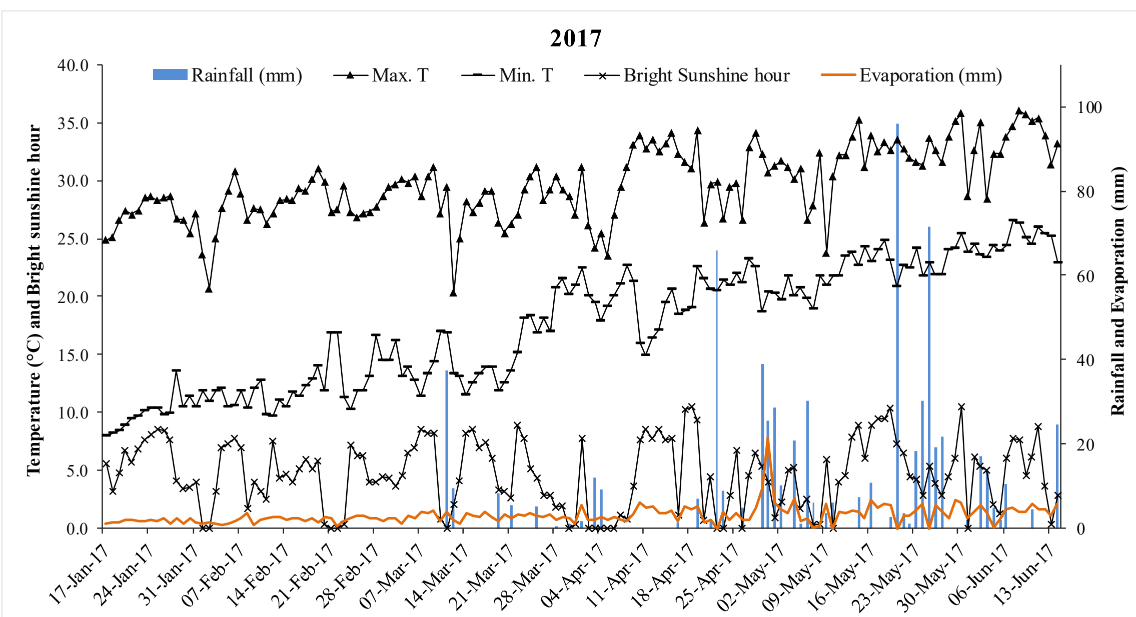
Recently, the area of *rabi* maize in northern districts of West Bengal including Cooch Behar has increased in a significant manner and rice-maize has become a very popular cropping system in this Teraiagro-climatic zone. The time of sowing of maize is an important and decisive factor having direct bearing on weather condition. It governs the crop's phenological development and total biomass production along with efficient conversion of biomass into economic yield. Field experiment by Singh *et al.* (1990) proved the growing degree day (GDD) requirement for maize cultivars in each growth phase is differentand also found high variations in GDD with different sowing dates which principally depend upon the maximum and minimum temperature of the crop-growing period. Maize sowing under late condition hastened development from seedling emergence to silking stage, while delayed sowing resulted in increased and decreased crop growth rate (CGR) respectively during the vegetative and post-anthesis stages (Cirilo and Andrade, 1994). Sowing of maize before and beyond the optimum date of planting resulted in reduction in leaf area index (LAI), leaf area duration (LAD) and total dry matter (Swanson and Wilhelm, 1996). Plants sown on earlier condition had an advantage with respect to plant height, LAI and dry matter accumulation over the delayed planting. However, the vegetative phase in case of late sowing condition was shortened by 6 days (Lauer, 2003). Delayed planting at early June decreased the number of days after planting to grain maturation by 9 days with respect to sowing at early May (Thomison *et al*. 2002). Planting date has been most crucial factor for significant losses in maize production due to extreme variations in temperatures during growth period from sowing to harvesting, most particularly at anthesis stage (Nielson *et al*., 2002). Considering the information it is to suggest that different dates of sowing with specific interval may generate sufficient information and clear understanding to find out the most suitable time of sowing for maize in pre-*kharif* season.

MATERIALS AND METHODS

Experimental site. The study was conducted in the instructional farm (26°19'86"N, 89°23'53"E) of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal in 2017 and 2018 during the pre-*kharif* orlate *rabi* season (Mid-January to mid-June). The location is situated in the eastern part of India with the elevation of 43 meters above mean sea level. The soil was sandy-loam in nature with the sand, silt and clay contents of 63.4% 20.4% slit and 17.2% respectively. The initial soil (0-20cm depth) recorded 162.6 and 155.4 kg of available Nha^{-1}(determined by Kjeldahl method), 10.7 and 12.2 kg of available Pha^{-1} (determined by Bray's No. I Method), and 84.3and 78.9 kg of available Kha^{-1} (determined by Flame photometer method) during the year 2017 and 2018respectively. The study area is characterized with sub-tropical humid climate with prolonged winter season. The average rainfall of this zone varies between 2100 and 3300 mm, while it has the temperature ranges from the minimum of 7-8 °C to the maximum of 24-33.2°C.

Treatment details. Sowing was performed in seven days interval starting from mid-January to mid-February for both the year in such a way that latest and earliest possible dates for maize and green gram sowing were included in the tested site. The experiment was laid out in split plot design having five main-plot treatments as sowing dates *i.e.* 17 January (3^{rd} meteorological week), 24 January (4^{th} meteorological week), 31 (January 5^{th} meteorological week), 7 February (6^{th} meteorological week) and 7 February (7^{th} meteorological week); and three sub-plot treatments *i.e.* sole maize, maize + green gram (1:1) and maize + green gram (1:2) with three replications. Maize variety 'DHM 117' and green gram variety 'Pusa Baisakhi' was taken for the experiment. Individual plot size of 4 m ×3 m was maintained in the trial.

Statistical analysis. All the data obtained from the experiment conducted under split plot design were statistically analyzed using the 'F-test' as per the procedure given by Gomez and Gomez (1984). Critical difference values at P=0.05 were used to determine the significance of difference between treatment means.



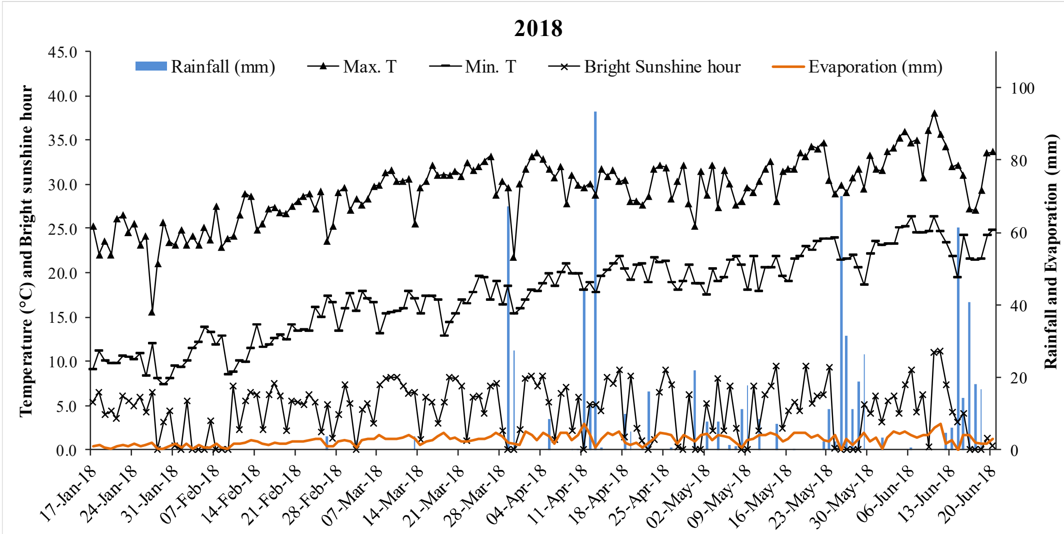


Fig. 1. Weather condition during crop growing period in 2017 and 2018.

RESULTS AND DISCUSSION

A. Plant growth attributes

Plant height. Maize sown on 7th and 14th February was recorded with greater plant height at all the stages of growth compared to the previously sown plants (Table 1). However, difference in plant height at maturity was very narrow among maize plants sown on different dates. Among the cropping system sole maize recorded significantly highest plant at all the dates of growth stages. Maize + green gram (1:2) recorded significantly lowest plant height irrespective of the growth stages. These results are in accordance with the findings of Singh (2005).

Dry matter accumulation. February 14 sown maize recorded significantly highest value of dry matter at 30 and 50 DAS whereas, 31st January sown maize accumulated higher dry matter at 70 DAS, 90 DAS and at harvest (Table 2).

Table 1: Effect of sowing dates and cropping systems on plant height (cm) of maize.

	30 DAS		50 DAS		70 DAS		90 DAS		At harvest	
Treatment	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Sowing date										
17 Jan	28.28	26.1	74.51	72.51	128.88	125.74	181.94	176.55	186.47	184.49
24 Jan	29.0	27.2	77.63	75.53	133.50	129.30	183.06	178.35	187.27	187.16
31 Jan	29.8	28.0	79.08	77.20	134.54	131.30	183.21	180.03	187.96	185.84
7 Feb	34.1	32.2	80.38	78.70	137.58	132.86	183.38	179.09	187.01	187.43
14 Feb	37.4	35.9	82.18	80.07	141.93	136.90	184.09	179.80	188.58	186.44
SEm±	0.81	1.19	1.39	1.21	2.26	2.44	1.53	1.53	1.49	1.54
CD (P= 0.05)	2.63	3.89	4.53	3.94	7.36	NS	NS	NS	NS	NS
Cropping system										
Sole Maize	33.08	31.24	81.31	79.17	136.51	132.99	184.85	180.98	189.01	187.92
Maize+ green gram (1:1)	31.40	29.46	78.12	76.20	134.02	129.32	180.76	177.51	185.44	184.97
Maize+ green gram (1:2)	30.72	28.88	76.84	75.03	135.32	131.36	183.80	178.80	187.33	185.33
SEm±	0.56	0.44	0.89	1.26	1.93	1.64	1.40	1.49	1.33	1.47
CD(P= 0.05)	1.65	1.30	2.62	NS	NS	NS	NS	NS	NS	NS

Table 2: Effect of sowing dates and cropping systems on dry mater accumulation (g plant^{-1}) of maize.

	30 DAS		50 DAS		70 DAS		90 DAS		At harvest	
Treatment	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Sowing date										
17 Jan	0.55	0.49	3.59	3.36	91.7	88.7	166.7	163.5	198.7	197.66
24 Jan	0.57	0.50	4.15	3.92	105.1	103.7	184.3	175.1	213.0	209.07
31 Jan	0.58	0.52	5.06	4.88	120.3	116.8	196.9	190.4	226.1	222.73
7 Feb	0.79	0.72	5.36	5.05	116.3	113.7	195.0	188.4	218.9	215.78
14 Feb	0.91	0.84	5.61	5.37	113.1	110.5	191.0	186.0	215.3	212.49
SEm±	0.03	0.02	0.22	0.20	4.13	5.00	5.11	5.73	5.34	6.12
CD (P= 0.05)	0.11	0.06	0.71	0.66	13.48	16.29	16.67	18.69	NS	NS
Cropping system										
Sole Maize	0.73	0.64	5.32	5.03	128.0	123.2	204.7	196.3	232.4	227.46
Maize+ green gram (1:1)	0.66	0.61	4.74	4.52	102.5	99.8	178.2	172.5	205.6	203.60
Maize+ green gram (1:2)	0.65	0.59	4.21	4.00	97.5	97.1	177.4	173.2	205.2	203.58
SEm±	0.02	0.02	0.15	0.15	4.35	4.06	6.40	6.02	6.63	6.22
CD(P= 0.05)	0.06	NS	0.45	0.43	12.85	11.99	18.87	17.75	19.57	18.34

The reason behind the lower dry matter accumulation for the early sown maize in all the dates of observations recorded might be due to lower night temperature which affected leaf production, cell division and cell enlargement. Among the cropping systems, sole maize produced highest dry matter followed by maize + green gram (1:1) and maize + green gram (1:2) at different stages of growth.

Leaf area index. Leaf area index (LAI) increased progressively with the growth of the plants and found maximum at 90 days after sowing after which it declined towards maturity due to senescence of lower leaf. At maximum LAI stage, 14th February planted maize recorded significantly highest LAI value over 17th January sown maize, however, other sowing dates were found with statistically similar LAI value with 14th February sown maize. Sole maize was found to best in terms of recorded LAI followed by the cropping system of maize + green gram (1:1) and maize + green gram (1:2) irrespective of the growth stages and year of experimentation. This might be due to favourable ecological condition formed due to lesser competition for space, nutrient, soil moisture and light. These results are in conformity with the findings of Dhingra *et al.* (1991).

The unfavourable weather condition i.e. lower day and night temperatures during the initial growth stages might be responsible for reduced growth attributes in early sown maize crops. Superior growth of sole maize was due to lesser competition for space, light, water and nutrients than in the intercropping systems. Similar findings were also scrutinized by Swanson and Wilhelm (1996); Irilo and Andrade (1994).

B. Yield attributing characters

Cob length and cob girth. February 7th sown maize for both the years 2017 and 2018 produced longest cob (16.33 and 14.95 cm respectively) which was statistically at par with February 14th sown maize (15.47 and 14.04 cm respectively) and January 24th sown maize (15.48 and 13.95 cm respectively) as represented in the Table 4. The lowest recorded lowest cob length was recorded for maize sown on January 17th which was 13.97 cm and 14.19 cm for2017 and 2018 respectively. This might be due to the unsuitable weather condition prevailing during initial growth stages. Liu *et al.* (2009) also reported similar trend of result. Among the three cropping systems, sole maize was recorded with the highest cob length of 16.13 and 14.83 cm respectively for 2017 and 2018, followed by the cob length of 14.97 and 13.47 cm for 2017 and 2018 under maize + green gram (1:1) cropping system. Cob girth was found to be significantly superior for maize sown on 14th February to other planting dates.

Number of seeds row^{-1} and number of seed rows cob^{-1} of maize. February 7th sown maize was recorded with significantly higher number of seeds row^{-1} than 17th January planted maize, however, number of seed rows cob^{-1} was found highest for the 31st January planted maize which was statistically at par with February 7th sown maize (Table 4). Sowing maize on 17th January was recorded with significantly lowest number of seeds row^{-1} and number of seed rows cob^{-1} for both the years of experimentation which might be due to affected plant growth and development and also reduced synthesis and translocation of photosynthates under lower day and night temperature and reduced solar light intensity particularly during early stages of crop growth. Similar findings were also scrutinized by Jasemi *et al.* (2013). Among the cropping systems, sole maize was observed with higher values of number of seeds row^{-1} (38.0 and 36.6 for the year 2017 and 2018, receptively). The number of seed rows cob^{-1} of 16.53 and 16.14 recorded in 2017 and 2018 for sole maize was also highest followed by maize + green gram (1:1) and maize + green gram (1:2). These results confirm the findings of Padhi (2001).

Test weight, total seeds cob^{-1}, cob weight, grain weight cob^{-1} and shelling percentage. February 14th sown maize recorded highest value of test weight, though test weight obtained with other dates of sowing was statically at par (Table 5). The highest test weight of 248.5 g and 248.20 g (respectively for the year 2017 and 2018) was recorded under the cropping system of sole maize followed by maize + green gram (1:1) and maize + green gram (1:2). Similar trends were also registered by Reddy and Bheemaiah (1991).The cob weight of maize in different sowing dates and cropping systems varied significantly for both the seasons as represented in the Table 5. Sowing on 7th February was resulted in highest cob weight of 184.0 g and 179.8 g which was statistically at par with the sowing on 31st January and 14th February. Sole maize obtained the cob weight of 184.7 g and 179.2 g in 2017 and 2018 respectively which was the highest and also statistically different from maize + green gram (1:2) and maize + green gram (1: 1) in both the seasons. Similar results were also reported by Sarkar and Shit (1990). The differences in the grain weight cob^{-1} of maize under different sowing dates and cropping systems observed for both the seasons have been presented in the Table 5. Maize sown on February 7th obtained the highest grain weight cob^{-1} of 152.9 g and 150.3 g (for the year 2017 and 2018 respectively) which was statistically at par with the sowing dates of 31st January and 14th February for both the years. Among the cropping systems, sole maize was the best performer in terms of recorded grain weight cob^{-1} which was 156.6 g and 151.7 g in 2017 and 2018 respectively. Data regarding the shelling percentage were found statistically non-significant with varied sowing dates for both the seasons (2017 and 2018). Recorded shelling percentage of 84.6 in the first season *i.e*. 2017 for the cropping system of sole maize was at par with two other intercropping systems but for the second season *i.e.* 2018 sole maize recorded shelling percentage of 84.5 which was significantly higher than the rest two cropping systems.

Yield and production efficiency. Grain yield of maize varied significantly under different dates of sowing and cropping systems as to be found from the Table 6. February 7th sowing recorded the highest grain yield *viz.* 9.61 t ha^{-1} and 9.32 t ha^{-1} for maize which was significantly superior to other dates of sowing in both the years except January 31st sowing in which maize obtained the grain yield of 9.40 t ha^{-1} and 8.95 t ha^{-1} (for

2017 and 2018 respectively). In the contrary, sowing performed on 17th January let the maize obtain the lowest grain yield which was 7.65 t ha^{-1} and 7.31 t ha^{-1} for the year 2017 and 2018 respectively. About more than 25% increment in grain yield of maize was observed when maize was sown on February 7th than that of January 17th for both the experimental years. The highest grain yield of 9.54 t ha^{-1} in 2017 and 9.12 t ha^{-1} in 2018 was obtained by maize crop when sown alone followed by the cropping system of maize + green gram (1: 2) that recorded the maize grain yield of 8.53 t ha^{-1} and 8.43 t ha^{-1} for 2017 and 2018 respectively. Lower grain yield might be due to the occurrence of rainfall during flowering stages of the crop which might be resulted into reduced pollination in the second season. The result was conformity with the Mandal *et al*. (2014).

The stover yield recorded in different sowing dates was also found to be significantly affected. The highest stover yield (12.97 t ha^{-1} and 13.07 t ha^{-1} for 2017 and 2018 respectively) was recorded in 6th meteorological week which was statistically at par with that of 5th meteorological week (13.23 tha^{-1} and 12.63 t ha^{-1} for 2017 and 2018 respectively). Sole maize was again the top performer in terms of obtainment of stover yield also (13.78 t ha^{-1} and 13.12 t ha^{-1} respectively for the experimental year 2017 and 2018). Next to it, maize recorded the stover yield of 11.94 t ha^{-1} and 11.65 t ha^{-1} for the first and second season respectively under the cropping system of maize + green gram (1: 2). These results were in conformity with the finding by Mandal *et al*. (2014).

The production efficiency of maize in different sowing dates and cropping systems was evaluated by harvest index (HI) and per-day grain production. The harvest index of maize was statistically in different among each other when different sowing dates were compared. Sowing on February 7th resulted in the obtainment of the highest harvest index for maize (42.68 and 41.95 respectively in 2017 and 2018) followed by the sowing on 31st January that recorded the HI of 41.82 and 41.91 in the first and second season, respectively. Harvest index was found to be lowest *i.e*. 39.99 and 39.92 under the sowing operation on 3rd meteorological for the experimental year 2017 and 2018 respectively. In terms of harvest index too, sole maize recorded its highest values *viz*., 41.34 and 43.12 (for 2017 and 2018 respectively) followed by the cropping system of maize + green gram (1: 2) that recorded the respective HI of 41.90 and 42.28 in 2017 and 2018. Similar findings as obtained by Patra *et al.* (1999) confirmed these present experimental results. Sowing of maize on February 7th was found to be superior in terms of per-day grain production to almost all the sowing dates (Fig. 2).

Table 3: Effect of sowing dates and cropping systems on LAI of maize.

	30 DAS		50 DAS		70 DAS		90 DAS		At harvest	
Treatment	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**
Sowing date										
17 Jan	1.01	0.94	2.47	2.20	4.09	3.93	4.60	4.45	3.78	3.69
24 Jan	1.04	0.95	2.64	2.34	4.15	3.98	4.61	4.49	3.84	3.73
31 Jan	1.04	0.97	2.69	2.41	4.18	4.08	4.62	4.48	3.85	3.72
7 Feb	1.18	1.06	2.71	2.44	4.28	4.10	4.66	4.53	3.92	3.73
14 Feb	1.32	1.16	2.81	2.52	4.32	4.13	4.67	4.54	3.88	3.75
SEm±	0.03	0.05	0.04	0.05	0.07	0.07	0.04	0.05	0.04	0.04
CD (P= 0.05)	0.10	0.15	0.15	0.17	0.22	0.22	NS	NS	NS	NS
Cropping system										
Sole Maize	1.17	1.06	2.73	2.41	4.29	4.11	4.67	4.53	3.90	3.76
Maize+ green gram (1:1)	1.10	1.00	2.66	2.39	4.19	4.00	4.59	4.47	3.78	3.69
Maize+ green gram (1:2)	1.09	0.99	2.60	2.35	4.13	4.01	4.64	4.50	3.88	3.72
SEm±	0.02	0.02	0.03	0.05	0.06	0.06	0.04	0.07	0.03	0.04
CD(P= 0.05)	0.07	0.05	0.08	0.14	0.16	0.18	NS	NS	0.10	0.11

Table 4: Effect of sowing dates and cropping systems on cob length, cob girth, number of seeds row^{-1} and number of seed row cob^{-1} of maize.

	Cob length(cm)		Cob girth (cm)		No. of seeds row^{-1}		No. of seed rows cob^{-1}	
Treatment	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**
Sowing date								
17 Jan	14.20	12.80	14.90	14.93	33.76	32.44	14.71	14.39
24 Jan	15.48	13.95	15.36	14.70	36.27	34.40	15.40	14.91
31 Jan	15.04	13.45	15.84	15.95	37.64	35.80	16.24	15.96
7 Feb	16.33	14.95	16.18	15.79	38.96	37.30	15.87	15.66
14 Feb	15.47	14.04	16.21	16.01	38.16	36.43	15.69	15.42
SEm±	0.36	0.30	0.69	0.70	0.75	1.01	0.31	0.586
CD (P= 0.05)	1.18	0.99	NS	NS	2.44	NS	NS	NS
Cropping system								
Sole Maize	16.13	14.83	16.42	16.23	38.00	36.60	16.53	16.14
Maize+ green gram (1:1)	14.97	13.47	15.04	14.74	35.89	34.35	14.88	14.53
Maize+ green gram (1:2)	14.81	13.23	15.64	15.44	36.97	34.88	15.33	15.13
SEm±	0.373	0.34	0.488	0.531	1.054	0.69	0.341	0.395
CD(P= 0.05)	1.10	1.00	NS	NS	NS	2.02	1.01	1.16

Table 5: Effect of sowing dates and cropping systems on test weight, total seeds cob^{-1}, cob weight, grain weight cob^{-1} and shelling % of maize.

	Test weight(g)		Total seeds cob^{-1}		Cob weight(g)		Grain weight cob^{-1} (g)		Shelling %	
Treatment	**2017**	**2018**	**2017**	**2018**	**2017**	**2017**	**2018**	**2017**	**2017**	**2018**
Sowing date										
17 Jan	245.7	243.4	497.95	480.5	150.2	146.9	124.3	119.9	82.6	81.5
24 Jan	246.1	243.8	559.31	531.1	165.8	159.8	137.5	130.8	82.7	81.8
31 Jan	246.3	246.2	614.00	592.9	178.1	173.4	151.4	144.6	84.6	83.1
7 Feb	249.9	248.6	621.79	604.4	184.0	179.8	152.9	150.3	82.8	83.4
14 Feb	248.2	247.0	596.41	581.8	177.1	173.9	148.1	143.8	83.6	82.5
SEm±	2.2	1.4	16.6	26.1	4.1	6.2	4.1	6.0	0.60	0.82
CD (P= 0.05)	NS	NS	54.91	86.4	13.6	20.1	13.5	19.5	NS	NS
Cropping system										
Sole Maize	248.5	248.2	629.8	611.0	184.7	179.2	156.6	151.7	84.6	84.5
Maize+ green gram (1:1)	246.0	243.6	535.4	515.2	160.5	156.0	131.6	126.5	81.7	81.1
Maize+ green gram (1:2)	247.2	245.7	568.4	548.3	167.9	165.1	140.4	135.4	83.5	81.8
SEm±	1.4	1.3	22.6	17.8	5.2	4.5	5.6	4.6	0.95	0.65
CD(P= 0.05)	NS	NS	66.6	52.8	15.3	13.2	16.8	13.4	NS	1.92

Table 6: Effect of sowing dates and cropping systems on grain yield, stover yield t ha^{-1} and harvest index of maize.

	Grain Yield (t ha^{-1})		Stover Yield (t ha^{-1})		Harvest Index	
Treatment	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**
Sowing date						
17 Jan	7.65	7.31	11.51	10.99	39.99	39.92
24 Jan	8.61	7.95	12.37	11.88	41.10	40.21
31 Jan	9.40	8.95	13.13	12.63	41.82	41.91
7 Feb	9.61	9.32	12.94	13.01	42.68	41.95
14 Feb	8.93	8.89	12.78	12.07	41.19	43.37
SEm±	0.21	0.47	0.35	0.578	0.39	0.87
CD (P= 0.05)	0.68	NS	NS	NS	1.29	NS
Cropping system						
Sole Maize	9.54	9.12	13.81	13.12	40.80	41.34
Maize+ green gram (1:1)	8.45	7.90	12.00	11.58	41.38	40.80
Maize+ green gram (1:2)	8.53	8.43	11.82	11.65	41.90	42.28
SEm±	0.23	0.21	0.43	0.297	0.54	0.64
CD(P= 0.05)	0.67	0.63	1.26	0.877	NS	NS

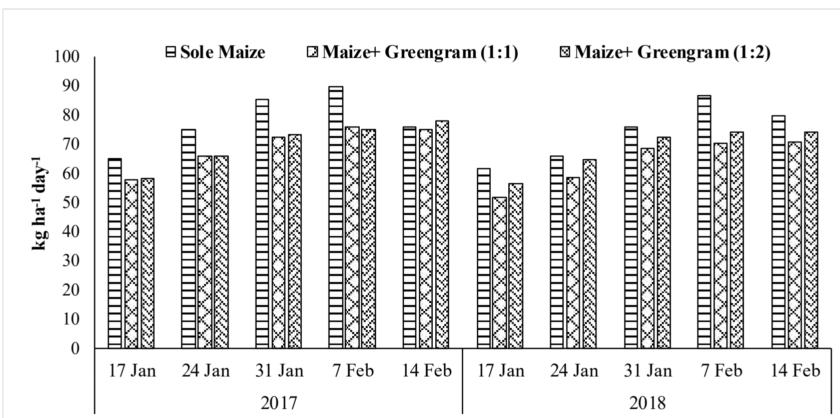


Fig. 2. Per-day grain production of maize under different sowing dates and cropping systems.

Growing sole maize was resulted in recording of highest values of per-day production among the cropping systems with all sowing dates except in February 14th sowing during the first year *i.e.* 2017. Maize requires accumulating optimum growing degree days (GDD) for the production of maximum grain yield and biological yield (Dahmardeh, 2012). Sowing maize after 31st January facilitated the crop to acquire optimum GDD due to congenial day and night temperatures which adversely affected the crops sown earlier.

CONCLUSION

In consideration with the results obtained from the two experimental years, it is suggested that the sowing for spring maize should be conducted at 6th meteorological week *i.e.* around 7th February. Drawing conclusion on the adaptability of the cropping systems requires further analysis on different cropping system parameters which were out of the focus area and objective of this present article.

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Conflicts of Interest. None.

REFERENCES

Cirilo, A. G. and Andrade, F. H. (1994). Sowing date and maize productivity: I. Crop growth and dry matter partitioning. *Crop Science*, *34*: 1039-1043.

Dhingra, K. K., Dhillon, M. S., Grewal, D. S. and Sharma, K. (1991). Performance of maize and mungbean intercropping in different planting patterns and row orientation. *Indian Journal of Agronomy*, *36*: 207-212.

DoES (2020). Agricultural Statistics at a Glance (2019). Directorate of Economics and Statistics. Department of Agriculture, Cooperation & Farmers Welfare. Ministry of Agriculture & Farmers Welfare. Government of India. http:// eands.dacnet.nic.in

Gomez, K. A., Gomez, A. (1984). Statistical Procedures for Agricultural Research, second ed. Wiley, New York.

Jasemi, M., Darabi, Fa and Naseri, R. (2013). Effect of planting date and nitrogen fertilizer application on grain yield and yield components in maize (SC 704). *American-Eurasian Journal Agriculture Environment Science*, *13*: 914-919.

Kumar, Ashok, Jat, S. L., Kumar, Ramesh, and Yadav, O. P. (2013). Directorate of Maize Research, Pusa Campus, New Delhi- 110 012, 123p

Lauer, J. (2003). Can we manage corn silage stover quality? *Field crops*, *28*: 5-36.

Liu, Ming, Tao, Hongbin, and Wang, Pu (2009). Effect of sowing date on growth and yield of spring-maize, Chinese *Journal of Ecological Agriculture, 17*: 8-23.

Mandal, M.K., Banerjee, M., Banerjee H., Alipatra, A. and Malik, G. C. (2014). Productivity of maize (Zea Mays) based intercropping system during kharif season under red and lateritic tract of West Bengal. An International Quarterly Journal of Life Science. *The Bioscan*, *9*: 31-35.

Nielson, R. L., Thomison, P. R. and Brown, G. A. (2002). Delayed planting date effects on flowering and grain maturation of corn. *Agronomy Journal*, *94*: 549-558.

Padhi, A. K. (2001). Effect of vegetable intercropping on productivity, economics and energetics of maize (*Zea mays). Indian Journal of Agronomy*, *46*: 204-210.

Patra, B. C., Mandal, B. B., Mandal, B. K. and Padhi, A. K. (1999). Suitability of maize (*Zea mays*) based inter cropping system**.** *The Indian Journal of Agricultural*, *69*: 759-762.

Ramachandiran, K. and Pazhanivelan, S. (2016). Abiotic factors (nitrogen and water) in maize: A review. *Agricultural Reviews, 37*(4): 317-324.

Reddy, K., Anand, and Bheemaiah, G. (1991). Effect of cropping systems and soil types on yield of maize.*Indian Journal of Agronomy*, *36*: 139-142.

Sarkar, R. K. and Shit, D. (1990). Effect of intercropping cereals, pulses and oilseeds with maize on production, competition and advantage. *Indian Agriculturist*, *34*: 89-98.

Singh, K. (2005). Performance of spring planted maize in relation to planting dates, methods of sowing and nitrogen levels. M.Sc. thesis, Department of Agronomy, Punjab Agricultural University, Ludhiana.

Swanson, S. P. and Wilhelm, W. W. (1996). Planting date and residue rate effects on growth, partitioning and yield of *Corn-Agronomy Journal*, *88*: 205-210.

Thomison, P. R. and Nielson, R. L. (2002). Impact of delayed planting on heat unit requirements for seed maturation in maize. *Pontificia Universidad Catolica de Chile Santiago*, *15*: 140-164.

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