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Full Length Research Paper

"Effect of tillage methods and sowing time on growth and productivity of maize, (*Zea mays*, var. Shalimar Maize Composite-6) under temperate conditions"

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A field experiment was conducted at Crop Research Farm Faculty of Agriculture, Wadura, during kharif 2017 on clay loam soil, to study the effect of tillage methods and sowing time on growth and productivity of maize,(*Zea mays,* var. Shalimar Maize Composite-6) under temperate conditions. The experiment comprising of 12 treatment combinations viz., 3 tillage methods (minimum tillage, ridge bed sowing, and conventional tillage) and 4 dates of sowing (20^{th,} 21st 22nd and 23rd meteorological standard week, was laid out in a strip plot design with three replications. The minimum tillage with the Ist sowing date i-e 20th meteorological standard week resulted in significantly higher grain (45.38qha^{-1}), (46.70 q ha^{-1}) , and Stover yield (65.73qha^{-1}), (69.12 q ha-^{1}) of maize along with all the growth and yield attributing characters studied. Analysis of the data revealed that minimum tillage with the Ist sowing date i-e 20th meteorological standard week had a significant effect on days to tasseling, days to silking, plant height, number of plants at 30 DAS and maturity, 100-grain weight, grain yield, biological yield.

Keywords: Maize, treatments, tillage, sowing date, strip plot, meteorological Standard week, Yield.

INTRODUCTION

Maize (*Zea mays L*.) is one of the most important cereal crops grown worldwide in a wider range of environments because of its greater adaptability. Globally, maize is known as "Queen" of cereals because it has the highest genetic productivity of 2.6 t ha^{-1}(Anonymous Economic survey, 2014).

Among the cereals, maize (Z*ea mays* L.) ranks third in total world, production of grains after wheat and rice. It is a staple food in many grain-production countries, particularly in the tropics and sub-tropics. Maize is cultivated in all soil types (except yield potential among the cereals. Globally maize is cultivated over an area of 177 million hectares with a production of 967 million metric tonnes and productivity of 5.5 million t ha^{-1}(FAO, 2014). In India, maize is cultivated on 9.3 million ha with a production of 24.2 million tonnes and in sandy soil, Being a photo insensitive crop, maize has been adopted in different seasons and in different regions, with crop duration ranging from 90-130 days.

In Jammu and Kashmir, the area under maize is 3.1 lakh hectares with a production of 52.7 lakh quintals and productivity is around 1.7 tonnes per hectare (Anonymous, 2015). The maize crop is generally grown under rainfed conditions and on marginal lands particularly in hilly terrains of the Kashmir valley invariably as an intercrop with pulses. Kashmir division is agro climatically a typical temperate region.

In Kashmir valley, maize is grown as a sole crop at an altitude range of 1850-2300m above mean sea level. The lack of potential varieties (composites & hybrids) having genes for moisture stress tolerance is one of the major reasons for low maize productivity in Kashmir as compared to the state average yield of 1.96 t ha^1.

The adoption of soil management practices which improves soil physical conditions and build up soil organic matter (SOM) may increase crop yield in eroded areas (Wright et al., 2008). The effects of tillage vary according to different soil types and properties, cropping sequence, residue addition, and climate. Few studies (Paustian et al., 2000; six et al., 2000) illustrated that tillage causes SOM decomposition and accelerates OM degradation which results in less OM build-up in the soil.

The increase in soil moisture as a result of conservation agriculture has the potential of enabling crops to surmount seasonal dry spells, mitigate the effects of drought and rainfall variability and reduce the risk of crop failure (Thierfelder and Wall, 2010). Conservation agriculture has significant potential to improve rainfall-use efficiency through increased water infiltration and decreased evaporation from the soil surface, with associated decreases in runoff and soil erosion (Thierfelder and Wall, 2009). However, decreased yield observed in the early years of conservation agriculture application, weed management that requires herbicides application, and lack of mulch due to priority given to feeding livestock constrains its adoption (Giller *et al.,* 2009). Several researchers conclude that CA is a system approach to sustainable agriculture (Chivenge *et al.,*2007; Govaerts *et al.,*2009; Mkoga *et al.,*2010; Li *et al.,*2011; Mrabet *et al.,*2012).

One of the most important factors contributing to the yield gap is the sowing of maize on inappropriate dates. Planting date is an important factor in farming which has a significant impact on crop growth and development and its yield and yield components (Mashreghi *et al.,* 2014). The planting date was reported to affect the growth and yield of maize significantly. Farmers who plant maize early are concerned about poor emergence and early plant growth (Beiragi *et al.,* 2011). In the present study, monthly sowings were planned to achieve perfect synchrony of flowering, to realize a good quantity of hybrid seed yield with the best quality. Earlier planting of corn is preferable because of utilization of the entire growing season, achieving physiological maturity before frost, and proper drying; thereby increasing profit through reduced drying costs (Lauer *et al.,* 1997) while delays in sowing date reduced individual kernel weight (Cirilo and Andrade, 1996). Yield can be increased to a greater extent provided high-yielding varieties are identified and planted at the proper time (Khan *et al.,* 2009 and Arif *et al.,* 2001). De *et al.* (1983) found that yield increased considerably by adjusting the sowing date to the best. The increase in yield by sowing crops at optimal sowing date could be due to the length of the growing period and depends on absorbing maximum nutrients from the soil and light from the sun resulting in maximum photosynthesis.

Current tillage practices, removal of residues, and nutrient mining without adequate replenishment leading to severe nutrient deficiency as well as climate variability, are the center core of soil fertility decline and low agricultural productivity. Through Conservation Agriculture (defined as minimal physical disturbance of soil through zero or minimum tillage, maintaining permanently soil covered by growing crop or dead mulch, and diversifying crop sequences and patterns as crop rotation and/or intercropping), it is expected that soil physical, chemical and biological properties as well as water productivity will be improved, hence lead to increased crop yields. The problem is Soil fertility decline leading to low agricultural productivity as a result of physical soil disturbance, nutrient mining, residue removal and climate variability. Intervention in conservation agriculture is No tillage or minimum tillage, raised bed on the soil surface and maintaining residues). Expected outputs are: Soil physical properties improved, soil chemical properties improved, organic matter built up, water use efficiency improved and hence increased crop yield.

Materials and Methods

A field experiment was conducted at the Faculty of Agriculture, Wadura, Sopore to investigate the “Effect of tillage methods and sowing time on growth and productivity of maize, (*Zea mays*, var. Shalimar Maize Composite-6) under temperate conditions was conducted during year 2017. It is located at latitude of 34° 34´ N, longitude 74°40´ E and altitude of 1590 m above mean sea level. The soil of the experimental field was silty clay loam in texture, neutral in reaction, low in available N (210 kg/ha) and P (12.3 kg/ha) and medium in available K (183.5kg/ha).

The tillage method consists of 3 methods i) Minimum tillage: T1 ii) Ridge bed sowing : T2 iii) Conventional tillage: T3 with 4 dates of sowing ($20^{th,}$ 21^{st} ,22^{nd} and 23^{rd} meteorological standard week, was laid out in strip plot design with three replications. Variety SMC-6 was used as the test variety. Well decomposed FYM at the rate of 15 t ha^{-1} was uniformly applied 5days before sowing to the plot and well mixed with soil. Before sowing, full dose of phosphorus and potassium at the rate of 60 kg and 40 kg P_2O_5 and K_2O ha^{-1}, respectively through Diammonium Phosphate (DAP) and Murate of Potash (MoP) was applied uniformly to each plot as basal dose. Nitrogen was applied at the rate of 120 kg ha^{-1}, half dose of nitrogen through DAP and urea was applied to each plot before sowing and remaining half dose of nitrogen through urea was top dressed in two equal splits, one at 30 days after sowing at knee high stage and 2nd dose at 50 to 55 days after sowing.

Climate and weather conditions

The mean meteorological data for the cropping season of 2017 recorded at Meteorological Observatory at FOA,

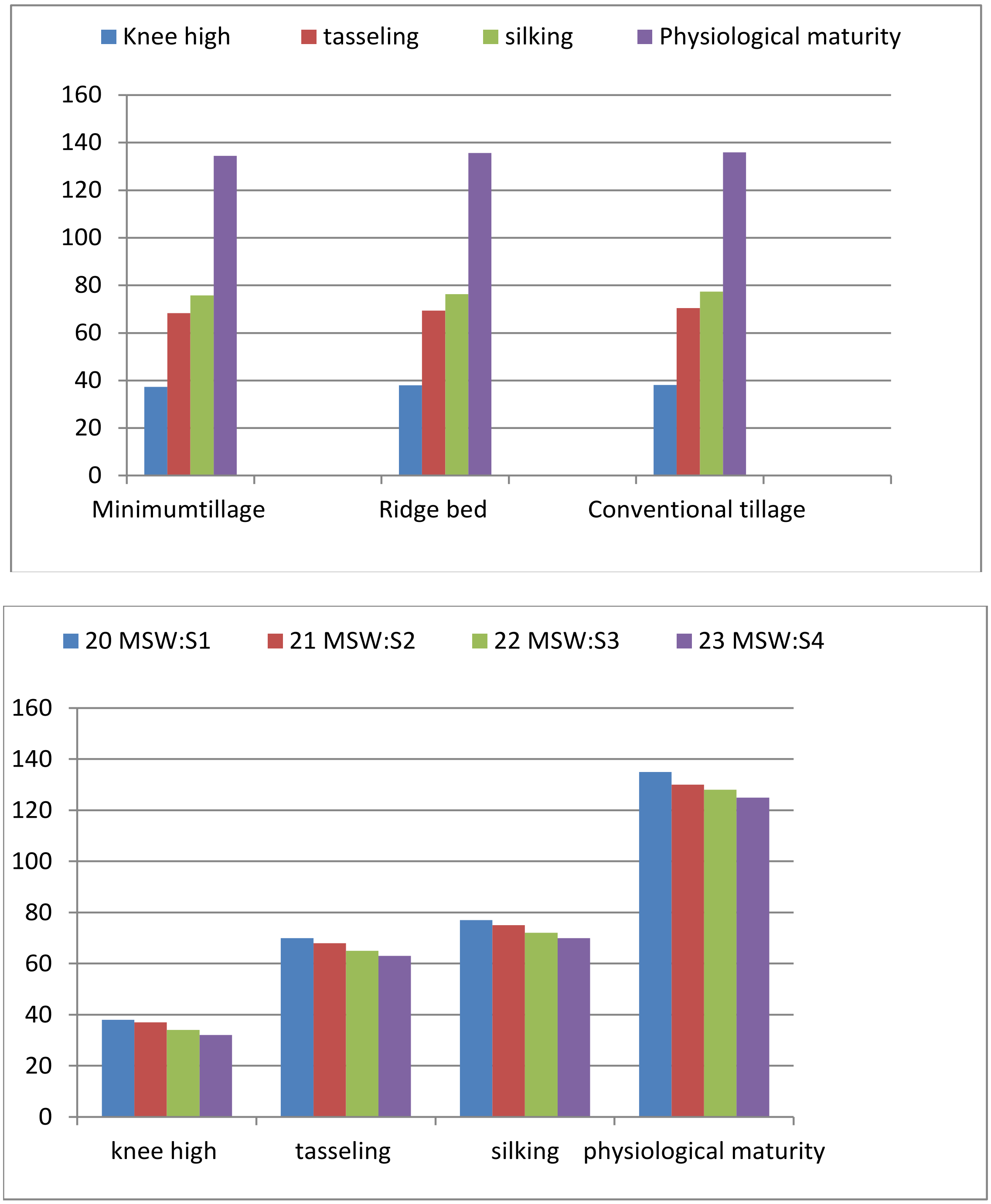

Figure 1. Days taken to reach different phenological stages as influenced by tillage methods and time of sowing

Wadura, are presented in Figure 1. It is evident from the data that mean maximum and minimum temperatures were 28.57°C and 14.01°C respectively and the total precipitation 359.07 mm observed during crop growth period of 2017. The total numbers of bright sunshine hours recorded during the crop growth period were 143.25hr and the mean maximum and minimum relative humidity were 81.53 % and 50.20 %, respectively during the crop growth period.

Physico-chemical characteristics of soil

Composite soil samples collected from 0 to 15 cm soil depth at the start of experiment during 2017 were subjected to mechanical and chemical analysis. The results revealed that the soil was medium in organic carbon with neutral pH.

Statistical analysis

The Software package used for analysis of data was “OPstat,” wherever the ‘F-test’ was found significant at 5 per cent probability; critical difference values were used to compare the treatment means. Further the relationship of different parameters was quantified by correlation and regression techniques as described by Cochran and Cox, 1967.

RESULTS AND DISCUSSIONS

Effect of tillage methods and sowing dates on maize.

Growth and yield

The experiment included three tillage treatments viz, minimum tillage (T1), Ridge bed sowing (T2) and conventional tillage (T3). The investigation results revealed that the plant height were significantly affected by tillage treatments. The highest plant height was found under treatment (T1) i.e minimum tillage than T1 and T2. . The reason for this may be due to sufficient moisture and nutrients availability in minimum tillage which hastened germination. While as in conventional and ridge bed sowing moisture loss is predominant due to which germination gets delayed and the crop doesn’t get sufficient time period to utilize the available growth resources. The results are in agreement with the observations of Jehan *et al*.(2011) who reported that planting methods had a significant effect on plant height. Maximum emergence m^{-2}, plant height, was obtained in reduced tillage.

The experiment also includes four dates of sowing viz., 20th meteorological standard week (S_1) 21th standard meteorological week (S_2), 22nd standard meteorological week (S_3) and 23nd standard meteorological week (S_4). There was significant and consistent increase in plant height in maize till 45 DAS in early sowing in 20th meteorological standard week MSW after which there was a decline in the rate of increase in plant height. The reason for the fact is that during 20th standard meteorological week the temperature was high which was conducive for the increase in the growth rate. The earlier planting resulted in taller plants compared to delayed sowing because as early sown crop got longer time period to utilize available growth resources. The results are in agreement with the observations of Moosavi *et al.* (2012) who reported that there is a significant decline in the plant height with the delay in the planting time of maize, this significant decrease in plant height following the delay in sowing can be associated with higher temperatures which the crop at the second and third sowing dates experienced, limiting their growing period and assimilate building because of the early maturity of plants. These results were inconformity with the results of Morin and Dormency (1993) and Imholte and Carte (1987).

Leaf area index is of paramount importance in all the crop plants, because optimum leaf area is required for maximum light interception which results in higher photosynthesis. Maximum leaf area index was found at 60 and 75 DAS in higher photosynthesis. Maximum leaf area index was found at 60 and 75 DAS in the plots where minimum tillage was practiced. In the middle phase of growth, leaf area index continued to increase while decreased towards maturity .The results were better in minimum tillage. This is due to the fact that due to early germination in minimum tillage the crop got sufficient time period to absorb all the nutrients that lead to better growth of leaves and hence more leaf area index was recorded. Leaf area index is of paramount importance in all the crop plants, because optimum leaf area is required for maximum light interception which results in higher photosynthesis. Delay in the time of sowing results in a significant decline in the leaf area index of the maize crop. The same results were obtained by Moosavi *et al.* (2012) who reported that there is a decline in the leaf area index of maize crop with delay in the sowing time. The same conclusion was also reported by Noferesti *et al.* (2006), delay of sowing leads to reduction in leaf area index of maize because of the shortening of growing cycle.

Dry matter accumulation was also influenced by tillage methods. Minimum tillage recorded higher dry matter accumulation than the conventional and ridge bed sowing. The reason could be exploitation of favorable soil factors and nutrient availability at important growth stages by minimum tillage and higher leaf area index which might have provided more photosynthetic area (LAI) and contributed more dry matter. Among soil management practices tillage improved soil properties viz. biological, physical and chemical and conserved soil moisture and increased crop production (Hejazi *et al.,* 2010)., the highest organic matter accumulation, the maximum root mass density (0-15cmsoildepth),and the improved physical and chemical properties were recorded in the conservational tillage practices, Md.Khairul et al., (2014). The results are in agreement with the observations of Zamir *et al* (2013) who recorded that reduced tillage + wheat straw mulch gave maximum 1000-grain weight (341.67 g) and grain yield (6.33 t ha-1) and it was followed by conventional tillage + saw dust mulch (4.92 t ha-1).

Dry matter accumulation and partitioning was highly influenced by the sowing time. Earlier date of planting recorded higher dry matter accumulation than the delayed sowing of maize. The reason could be exploitation of favourable climatic condition at important growth stages by the crop sown early and higher leaf

Table 1. Plant height (cm), Leaf area index, Dry matter Accumulation (q^{-1}ha)at harvesting stage of maize as influenced by tillage methods and sowing dates.

Treatment	Plant height(cm)	Leaf area index	Dry matter Accumulation(q^{-1}ha)
T1: Minimum tillage	241.88	2.359	75.21
T2: Ridge bedsowing	220.00	1.741	71.02
T3:Conventional Tillage	223.06	2.157	68.95
SE(m)±	**1.861**	**0.059**	**0.10**
CD (P≤0.05)	**7.503**	**0.239**	**0.40**
Sowing dates			
S_1: 20 MSW	220.49	2.20	68.75
S_2:21 MSW	204.01	1.89	66.30
S_3:22 MSW	197.70	1.63	61.66
S_4:23MSW	170.50	1.33	59.32
SE(m)±	**1.92**	**0.081**	**0.12**
CD (P≤0.05)	**5.750**	**0.242**	**0.36**

area index which might have provided more photosynthetic area (LAI) and contributed more dry matter. Earlier and timely sowing results in a significant increase in the dry matter accumulation in maize crop due to appropriate growing period available during growth phase as compared to delay in sowing (Girijesh *et al.,* 2011). Similar findings were reported by Ma *et al.* (2007) Table 1.

Economic yield of a crop is the outcome and contribution of its different yield components and therefore, optimization of the contribution of these yield components through proper and judicious application of various agronomic practices. One of the important agronomic practices that had a direct influence on the growth and yield of the respective crop are the tillage methods. In the present investigation ridge bed sowing and conventional tillage of maize resulted in a significant decline in the yield contributing components i.e., cob length, number of grains per cob, cobs per plant and 100 grain weight etc. which might be due to reduced growing period which results in reduced net photosynthates and decreased translocation rate of photosynthates from source to sink. The results are in agreement with the observations of Ramesh et al (2016) tillage methods in rabi season resulted in significantly highest emergence count (369.5 plants/m^2), tallest plants (17.7, 92.6 and 101.0 cm at 60, 120 and at harvest, respectively) with multi-crop planter. While, zero tillage recorded significantly higher crop growth rate (15.8 g/day/m^2) and relative growth rate (0.027 g/g/day) during 120-harvest stage. Hence, reduced tillage can be as good as other intensive tillage system besides lower input cost and environmental security. Conservation tillage defined here as reduced or minimum tillage with a crop residue mulch cover) shows considerable potential for stabilizing production of maize (Lal et al. 1978; Osuji 1984). Md.Khairul et al., (2014) conclude that zero tillage with 20% residue retention was found to be suitable for soil health and achieving optimum yield under the cropping system in Grey Terrace soil.

Effect of sowing time on grain and stover yield together with harvest index gives an overall picture of the relative

biomass production by a plant and its component analysis helps in estimating the relative harvest index. Maximum grain yield of maize i.e., 45.38 q ha^{-1} was obtained with sowing time of 20th standard meteorological week (s_1). The decline in the yield during 23rd standard meteorological week (s_4) may be due to the fact that the night temperature was below 10 ^{0}C (Appendix-I) which might have reduced germination and ultimately plant stand as compared to maize sown 20th meteorological standard week, when night temperature was above 10 ^{0}C which resulted in a higher germination rate thus a optimum plant population was maintained. The delayed sowing (23nd standard meteorological week) recorded a decline in the grain and stover yield, because of shorter time available for the late sown crop to utilize available growth resources (light, nutrients, moisture etc.,) responsible for lower LAI and poor plant growth leading to lesser dry matter production and partitioning of assimilates to sink for better vegetative growth, leading to a decline of yield and yield contributing components

Table 2. Grain yield (qha^{-1}), Stover yield (qha^{-1}), Total biological yield (qha^{-1}) and Harvest index (%) of maize as influenced by tillage methods.

Treatment	**Grain yield**	**Stover yield**	**Total biological yield**	**Harvest index**
T1: Minimum tillage	39.85	68.91	115.75	115.75
T2: Ridge bedsowing	38.16	61.02	104.07	42.0
T3: Conventional Tillage	36.46	55.16	96.16	43.5
SE(m)±	**0.63**	**6.617**	**7.01**	**0.02**
CD (P≤0.05)	**2.56**	**19.05**	**NS**	**NS**
Sowing dates				
S_1: 20 MSW	45.38	78.05	122.52	38.4
S_2:21 MSW	40.22	57.66	97.88	43.8
S_3:22 MSW	37.41	56.33	95.07	39.4
S_4:23MSW	29.61	54.55	84.16	49.2
SE(m)±	**0.35**	**5.88**	**5.98**	**0.02**
CD (P≤0.05)	**1.05**	**17.62**	**17.93**	**0.06**

than the timely sown crop. The results are in agreement with the results of Jaliya *et al.* (2008), Namakka *et al.* (2008) and Khan *et al.* (2002) Table 2.

Meteorological studies

Days taken to reach different phenological stages

Data presented in figure 4.7 indicated that various phenological stages viz., knee high, tasseling, silking, and physiological maturity were affected due to various treatments.

The tillage methods does not influence significantly the number of days to reach various phonological stages. The data revealed that days taken to reach various phenological stages was delayed in conventional tillage (T_3). Treatment (T_3) conventional tillage required more number of days to reach physiological maturity compared to other minimum tillage (T_1) and ridge bed sowing (T_2).

Perusal of the data on sowing dates indicated that with delay in sowing from 20th meteorological standard week (S_1) to 23rd meteorological standard week (S_4), days taken to reach various physiological stages significantly and consistently decreased at all growth stages except at 80% maturity. Days taken to reach silking were 77.4, 75.5, 72.0 and 70.3 days for 20th , 21st, 22nd and 23rd meteorological standard week, sown crop respectively. For physiological maturity crop took 135.3, 130.5, 128.1 and 125.5 days for, 20th, 21st, 22nd and 23rd meteorological standard week, sown crop respectively. Date of sowing significantly affected the number of days taken to reach different phenological stages Table 3.

Growing degree days (^{o}C days) taken to different phenological stages by maize

Data in the Tables 4-8, indicated that growing degree days were significantly affected by planting dates at tasseling, silking stage and at harvesting, respectively. It was observed that sowing done on 20th meteorological standard week (S_1) had took highest heat units to knee high (356.15), tasseling stage (741.55), silking stage (882.28) and to maturity (1536.10), followed by 21st meteorological standard week (S_2) which taken 345.15, 715.55, 850.55 and 1488.8 heat units to knee high, tasseling stage, silking stage and at maturity, respectively. The lowest heat units were recorded by 23rd meteorological standard week (S_4) planting for knee high (297.4), tasseling stage (678.5), silking stage (773.85) and to harvest completion (1438.85), respectively.

Relative economics

Relative economics in terms of net returns and benefit

Table-3. Days taken to reach different phenological stages as influenced by tillage methods and time of sowing

Treatments	Days to reach various phenological stages			
	Knee high	Tasseling	Silking	Physiological maturity
Tillage methods				
1 Minimum tillage	37.3	68.3	75.7	134.4
2 Ridge bed sowing	38.0	69.3	76.3	135.6
3 Conventional tillage	38.1	70.5	77.4	135.9
SE(m)±	**0.27**	**0.72**	**0.55**	**0.24**
CD (P≤0.05)	**0.83**	**2.17**	**1.66**	**N/S**
Sowing dates : 4				
1 20 MSW	38.0	70.1	77.4	135.3
2 21 MSW	37.2	68.1	75.5	130.5
3 22 MSW	34.5	65.0	72.0	128.1
4 23 MSW	32.5	63.3	70.3	125.6
SE(m)±	**0.17**	**0.22**	**0.21**	**0.24**
CD (P≤0.05)	**0.50**	**0.62**	**0.65**	**0.74**

Table 4. (GDD) Growing degree days of maize as influenced by tillage methods and time of sowing

Sowing dates	GDD at various phenological stages (Growing degree-days)			
	Knee high stage	Tasseling stage	Silking stage	Physiological maturity
20th MSW	356.15	741.55	882.28	1536.1
21st MSW	345.15	715.55	850.55	1488.8
22nd MSW	309.85	702.55	804.31	1469.3
23rd MSW	297.4	678.55	773.85	1438.85
Tillage methods				
Minimum tillage	345.15	751.55	850.55	1536.1
Ridge bed sowing	356.15	747.55	840.55	1530.1
Conventional tillage	356.15	741.55	840.55	1526.1

cost ratio with respect to green cob yield and fodder yield of maize was worked out for various treatment combinations. It is evident from the data that highest net return and benefit cost ratio of ₹79873.6 and 2.2 with treatment combination of maize sown in 20th standard meteorological week and minimum tillage, hence this

Table-5. HTU (Heliothermal units) of maize as influenced by tillage methods and time of sowing

Sowing dates	**HTU at various phenological stages (Heliothermal units)**			
	Knee high stage	**Tasseling stage**	**Silking stage**	**Physiological maturity**
20^{th} MSW	2658.1	5481.9	6107.4	10978.1
21^{st} MSW	2586.8	5317.0	6088.6	10575.3
22^{nd} MSW	2520.7	5017.3	5729.7	10384.1
23^{rd} MSW	2263.7	4915.7	5481.9	10156.7
Tillage methods				
Minimum tillage	2686.8	5481.9	6088.6	10978.1
Ridge bed sowing	2658.1	5471.9	5729.7	10973.1
Conventional tillage	2658.1	5466.9	5481.9	10968.1

Table-6: HYTU (Hydrothermal units) of maize as influenced by tillage methods and time of sowing

Sowing dates	**HYTU at various phenological stages**			
	Knee high stage	**Tasseling stage**	**Silking stage**	**Physiological maturity**
20^{th} MSW	22004.35	49049.22	55872.3	97992.9
21^{st} MSW	21311.35	47269.22	53815.6	95178.9
22^{nd} MSW	19255.7	44585.22	50852.3	93992.4
23^{rd} MSW	17630	42589.47	49049.2	92292.7
Tillage methods				
Minimum tillage	21311.35	49049.22	55872.3	97992.9
Ridge bed sowing	22004.35	44585.22	53815.6	93992.4
Conventional tillage	22004.35	42589.47	53715.6	92292.7

treatment combination was recommended for obtaining most profitable grain yield of maize. Lowest net profit and benefit cost ratio of ₹39685.27and 0.7was recorded in 23^{rd} standard meteorological week with ridge bed sowing.

CONCLUSION

The higher yield was obtained with Sowing done on 20^{th} meteorological standard week had a significant effect on the growth, yield attributes, yield and stover yield of maize. Minimum tillage resulted in higher grain and stover yield significantly. Further, sowing on 20^{th} meteorological standard week (S_1) with minimum tillage (T_1) recorded highest benefit cost ratio and net returns. Thus the results of the study lead to the conclusion that to realize higher grain and stover yield of maize variety

Table 7. PTU (photo thermal units) at various phenological stages of maize as influenced by tillage methods and time of sowing

	PTU at various phenological stages			
Sowing dates	**Knee high stage**	**Tasseling stage**	**Silking stage**	**Physiological maturity**
20th MSW	4865.38	10566.31	12022.68	20279.21
21st MSW	4705	10185.54	11593.16	19718.56
22nd MSW	4375.60	9632.09	10974.87	19485.51
23rd MSW	4056.02	9280.03	10566.31	19119.47
Tillage methods				
Minimum tillage	4705	10545.31	11593.16	20179.21
Ridge bed sowing	4865.38	10266.31	10974.87	19485.51
Conventional tillage	4855.38	10146.31	10566.31	19119.47

Table 8. Heat use efficiency at different growth stages of maize as influenced by tillage methods and time of sowing

Treatment combination	15 DAS	30 DAS	60 DAS	75 DAS	90 DAS	105 DAS
Minimum tillage(T_1)						
T_1S_1	0.12	1.04	3.55	18.37	10.15	12.71
T_1S_2	0.09	0.68	3.31	19.02	6.86	13.18
T_1S_3	0.03	0.19	2.92	17.20	6.84	11.97
T_1S_4	0.01	0.14	2.03	16.34	5.95	10.89
Ridge bed sowing(T2)						
T_2S_1	0.06	0.51	3.87	18.63	8.72	13.13
T_2S_2	0.03	0.29	3.90	18.91	6.32	13.09
T_2S_3	0.01	0.18	2.53	15.85	6.96	11.05
T_2S_4	0.01	0.12	2.01	14.98	5.94	10.97
Conventional tillage(T_3)						
T_3S_1	0.01	0.38	4.15	19.71	9.34	13.96
T_3S_2	0.03	0.19	3.35	16.51	6.90	11.57
T_3S_3	0.02	0.17	2.82	16.71	6.33	11.66
T_3S_4	0.01	0.11	2.12	15.57	5.91	10.94

SMC-6 under Kashmir valley conditions, it should be planted on 20th meteorological standard week with minimum tillage.

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