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Short Communication

Effect of row direction, sowing date and mulching on the microclimate of *rabi* maize under Namsai region of Arunachal Pradesh

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Maize is the most important *rabi* season crop of north-eastern India and its higher yield may be achieved through improved planting techniques and appropriate agro-management practices.Various management options *viz.* date of sowing, row direction, mulching, *etc.* are important production components which can be manipulated to counter the adverse effects of climate change.Pathan *et al.* (2006) reported that higher wheat and barley yield achieved from more intercepted photosynthetically active radiation (PAR) oriented in east-west direction. Similarly, change in available radiation due to effect of planting direction also impacted the yield of soybean (Bhagat *et al.,* 2017).

Mulches have been found to increase the soil moisture, leaf area index (LAI), PAR interception and thereby seed yield of mustard (Saikia *et al.,* 2014). Saha *et al.* (2010) reported that the black plastic mulch resulted in an increase in soil temperatures, the decrease in canopy temperatures, that resulted in less incidence of leaf curl disease in tomato. InArunachal Pradesh, Banana is grown in the large area and more wild cultivars cover a large area.Banana leaves are destroyed after harvesting every year which is usually burnt and decayed in the forest. To address these major problems of the state,the experiments were planned for increasing maize production. The field experiments were conducted during *rabi* seasons of 2017-18 and 2018-19 at the research farm, Arunachal University of Studies, Namsai, Arunachal Pradesh. This area is characterized by Warm Perhumid Eco-sub region with sandy loam soil.

Maize variety (Deccan Hybrid) was sown on 10th October, 20th October and 30th October in split-split plot design with treatments as row direction in main plots and mulching in sub plots with three replications. The crop was sown in two-row directions viz, east-west (E-W) and north-south (N-S) with and two mulch treatments viz. M1(mulch) and M2 (No mulch). The banana leaves mulch applied at 5000 kg ha^{-1}after the emergence of a crop after 12 days sowing. The soil temperature was recorded at 10 cm depth at 7.30 am and 2.30 pm twice a week. Canopy temperature was measured at one-week interval with the help of Infrared Thermometer (FLUKE-574) at 2.30 p.m. from fully developed canopy till its physiological maturity. Intercepted Photosynthetically Active Radiation (IPAR) was measuredwith Line Quantum Sensor at 10 days interval. IPAR was calculated using the following formula (Kumar *et al.,* 2008).

$$\text{IPAR (\%)} = \text{PAR (I)} - [\text{PAR (T)} + \text{PAR (R)}] / \text{PAR (I)} \times 100$$

Where, PAR(I) is incident PAR; PAR(T) is transmitted PAR; PAR(R) is reflected PAR

Recording of soil moisture, soil samples were collected from each plot at 15 days interval from sowing to harvesting from 0-15 and 15-30 cm soil depth. The collected samples were dried in the oven at a temperatureof 105°C. Soil moisture was measured on a percent volume basis and calculated by Standard Gravimetric Method as follow givenby Dastane (1967);

Soil water content (%) = Soil water content (weightbasis) x Bulk density x Depth of soil (cm)/100

For grain sampling, five plants were tagged randomly in each net plot area for recording observations that did not involve destructive sampling. When cobs were yellow around 95 per cent of plants were taken as maturity stage. Grain and stover yield was recorded from the net plot at the time of harvesting of the crop. The length of the cobs collected from the tagged plants was measured from the base to the tip of the cob by making the points on graph paper and the mean value was expressed as the length of the cob in cm.

Microclimate characters

The intercepted PAR varied with leaf area index (LAI) and maximum Intercepted PAR was recorded at maximum LAI. On average, intercepted PAR was higher (84.6%) in E-W row direction as compared to N-S row direction (80.2%) (Table1).On an average intercepted PAR were higher (73.8

Table 1: Canopy temperature (°C), PAR interception (%), soil temperature (°C) and soil moisture (%) of maize production under different row direction, sowing date and mulch status during 2017-18 and 2018-19 (Mean of two years)

Treatments	Canopy temperature (°C)	PAR interception (%)	Soil temperature (°C)	Soil moisture (%)
Row direction				
North-South	16.3	84.6	12.6	20.4
East-West	14.5	80.2	12.2	25.6
Sowing date				
10 October	14.3	83.8	12.8	24.6
20 October	15.1	81.6	10.2	23.4
30 October	16.6	79.9	10.8	21.2
Mulch status				
Mulch (M1)	14.0	82.4	14.2	26.8
No mulch (M2)	16.5	78.6	12.7	21.6

Table 2: Yield attributing characters of maize production under different row direction, sowing date and mulch status during 2017-18 and 2018-19 (Mean of two years)

Treatments	Number of cobs per plant	Cob length (cm)	Number of grains per cob	Grain weight per cob (g)	Stover yield (kg ha^{-1})	Grain yield (kg ha^{-1})
Row direction						
North-South	1.09	17.63	380	110.8	6010	5410
East-WestCD	1.35	19.32	495	142.5	7985	6890
(p=0.05)	0.18	2.39	39.21	4.23	340	337
Sowing date						
10 October	1.48	19.83	492	142.4	7980	6895
20 October	1.23	17.45	356	128.2	6354	5390
30 OctoberCD	1.12	15.35	268	114.1	5230	4143
(p=0.05)	0.21	2.36	39.46	3.89	535	490
Mulch status						
Mulch	1.46	19.65	496	143.3	7992	6892
No mulch	1.16	16.21	275	117.4	5654	4256
CD (p=0.05)	0.19	2.36	38.25	4.26	336	312

%) on 15th October as compared to 20th October (81.6 %) and 30 October (79.9 %) during both years of study (Table 1). Intercepted PAR was higher (82.4%) in the mulched crop as compared to non-mulched crop (78.6%). Saikia *et al.* (2014) also observed higher intercepted PAR by mustard under mulch as compared to no mulch treatment.

The data revealed that canopy temperature was higher (1.8 °C) in the north-south row direction as compared to east-west row direction during both the years of study (Table 1).Early sown maize (10 October) significantly higher canopy temperature as compared to maize sown on 20 October and 30 October (Table 1). This was due to higher leaf area index recorded when maize was sown on 10 Octobers resulting in higher transpiration, thus canopy temperature remained lower due to higher transpiration as compared to late sown crop. The canopy temperature was 2.5°C lower under mulched crop as compared to without mulched crop during both years. Saha *et al.* (2010) also reported that a decrease in canopy temperature in tomato under black plastic mulch.

The data revealed that mean soil temperature was higher under north-south row direction as compared to the east-west row direction. (Table 1). Among the different maize sown dates, mean soil temperature was higher when maize is sown on 10 October followed by 20 October and 30 October during both years of pooled analysis whereasmean soil temperature was 1.5°C higher in the mulched crop as compared to without mulched crop.

Soil moisture was recorded higher under east-west row direction as compared to the north-south row direction. Among different date of sowing, soil moisture was higher on 10 October followed by 20 October and 30 October. Soil moisture was recorded higher in the mulched crop as compared to without mulched crop during both the years. Saikia *et al.* (2014) also observed higher (8.6 to 30%) soil moisture under mulching in the mustard crop.

Yield and yield attributing characters

The number of cobs per plant was higher in the east-west direction (1.35) and then north-south row direction (1.09). The significantly higher number of cobs per plant (1.48) was recorded when maize is sown on10 October as compared to 20 October (1.23) and 30 October (1.12). Numbers of cobs per plant were significantly higher (1.46) in the mulched crop as compared to non-mulched (1.16) during both the years of experiment.

Cob length was recorded higher in the east-west direction (19.32) as compared to the north-south direction (17.63). The cob length was higher when maize sown on 10 October as compared to 20 October and 30 October. Significantly higher cob length of 19.65 cm was in the mulched crop as compared to non-mulched crop (16.21 cm). The number of grains per cob was higher in the east-west row direction as compared to the north-south row direction. Among the sowing date number of grains per cob recorded was higher when maize sown 10 October. It was higher in the mulched crop as compared to without mulched crop. The grain weight per cobs was recorded statistically in all the treatments. Significantly higher grain yield (6890 kg ha^{-1}) was recorded in the east-west row direction as compared to north-south row direction (5410 kg ha^{-1}) (Table 2). This was due to higher intercepted PAR in east-west row direction than north-south row direction (Table 1). The higher maize stover yield (7985 kg ha^{-1}) was recorded in the east-west row direction as compared to north-south row directions (6010 kg ha^{-1}).

Among the sowing date, the significantly higher maize grain and straw yield were recorded when maize sown 10 October as compared to 20 October and 30 October. The higher grain and straw yield recorded due to higher intercepted photosynthetically active radiation (IPAR) in early maize sown as compared to late sown during both the years of the experiment (Table 1).

It can be concluded that intercepted PAR was higher in the east-west row direction as compared to north-south row direction resulting higher grain yield in the east-west row direction sown crop. It was also found that, higher grain yield and maize stover yields were recorded when crop got sown on 10 October as compared to 20 and 30 October. Therefore in Namsai region, *rabi* maize should be sown around 10 October in east-west row directionso as to achieve better yield along with mulch application @5000 kg ha^{-1}(banana leaves).

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