International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 14, Issue 11, 2022, pp.-11850-11852.
Available online at https://bioinfopublication.org/pages/jouarchive.php?id=BPJ0000217

Research Article

IMPROVING SURVIVAL AND DRY MATTER PARTITIONING OF LATE PLANTED MAIZE (*Zea mays*) IN FRAGILE ECOSYSTEM OF MEGHALAYA THROUGH LAND CONFIGURATION

SHAHANE A.A.[1]* AND BEHERA U.K.[2]
[1]Department of Agronomy, College of Agriculture, Kyrdem Kulai, 793105, Meghalaya, Central Agricultural University, Imphal, 795004, Manipur, India
[2]Dean, College of Agriculture, Kyrdem Kulai, 793105, Meghalaya, Central Agricultural University, Imphal, 795004, Manipur, India
*Corresponding Author: Email - amitiari89@gmail.com

Received: November 04, 2022; Revised: November 26, 2022; Accepted: November 27, 2022; Published: November 30, 2022

Abstract: The field experiment was conducted at Instructional Farm of college of Agriculture (CAU-I), Kyrdemkulai, Meghalaya (25°74' N latitude, 91°81' E longitude and 700 meter above mean sea level) in split plot design involving three land configuration (Flat bed (FB), Furrow irrigated raised bed (FIRB) and ridges and furrow (RF) as main plot and four maize varieties (RCM-76, RCM-75, DA-61-A and RCM 1-2) as sub-plot treatments in *kharif* season of 2020-21.Result showed that, ridges and furrow found superior in terms of survival of plant as well as dry matter production for all four varieties tested. Increase in dry matter at in RF was 1.1-2.6 g/plant for shoot, 0.4-0.9 g/plant for root, 0.1-0.4 g/plant for leaf, 0.3-0.5 g/plant for tassel and 3.0-6.9 g/plant for cob over other land configurations. Maize variety DA-61-A and RCM-76 grown in RF found superior in survival and plant producing cods and tassel with survival of 64.9-65.5 % plant population at harvest; while 49.1-53.4 % and 33.3-36.2 % plant produce tassel and cobs, respectively. For dry matter production, RCM-76 sown in RF found superior 0.6-2.6g/plant and 1.0 -10.6 g/plant higher dry matter than rest of varieties grown in same land configuration at 60 DAS and at harvest, respectively.

Keywords: *DA-61-1, RCM-76, Dry matter partitioning, Land configuration*

Citation: Shahane A.A. and Behera U.K. (2022) Improving Survival and Dry Matter Partitioning of Late Planted Maize (*Zea mays*) in Fragile Ecosystem of Meghalaya through Land Configuration. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 14, Issue 11, pp.- 11850-11852.

Academic Editor / Reviewer: Dr Jay Bhavsar

Introduction

The maize (*Zea mays*) is a promising cereal known for its higher productivity, capacity to cater the need of animal feed, high diversity of uses, wider adoptability and short growing season, higher nutrient requirement and responsiveness to nutrient application. Besides that, crop is also known for its higher sensitivity to water stress, nutrient stress and different biotic stresses. The crop is grown in India with on 9.9 million ha. area with production of 31.5 million tonnes in 2020-21; while in Meghalaya maize occupies second position in area occupied after rice with 18,152 ha area producing 41,624 metric tonne of maize grain. The productivity of maize in Meghalaya (2293 kg/ha)[1] is below national average productivity of 3195 kg/ha (2020-21).The different constraints and condition offered by soil and climatic condition in state for maize cultivation are soil topography and relief, soil acidity, soil depth, soil erosion, washing out of manure, higher rainfall and difficulty in implementation of modern agrochemical based production system. Besides that, maize is cultivated mainly under organic production system making it difficult to meet the nutrient need of crop to attend the desired productivity level due to low and variable nutrient content in manure as well as difficulty in accounting nutrient added. Hence, managing these conditions and constraints is needed to providing expected soil and climatic conditions suitable for crop growth and making the desired use of applied input for enhancing growth and productivity. The variation in space dimension across state can be explained rainfall varies from 2119 to 6019 mm [2], soil organic matter (varies from 1.0 % to 5.5 %) [3] and altitude (varies from 300 to 2000 m) [4]. In this regards, study of intervention for managing above mentioned constraints is at most important in state with significant variability of soil and climatic condition cross region and even district of state too.

Different practice such as land configuration, sowing time, varietal selection and selection of area has potential to crab these adverse effects and their potential need to be quantified.

Besides reducing effect of natural stresses on crop performance these options are also contributes significantly for improving crop productivity. Choudhary (2016) [5] reported that, increasing grain yield of maize in ridges and furrow along with more efficient use of rain water; while variations in grain yield across different land configuration was shown by Halli and Angadi (2019) [6]. The sowing time in non-monitory input in production system of any crop and its significance is more in rainfaed agriculture; while in Meghalaya the sowing time selection is important to avoid the excess water stress as well as reducing the impact of rainfall on pollination, fertilization and damage to grain during maturity. The varieties have their different genetic potential and also respond differently to stresses. The variation in yield level of different maize varieties under organic farming faming system and their tolerance to different stress in high rainfall condition was reported by Layek, *et al*., (2016) [7] and Ramkrushna, *et al*., (2018) [8]. Considering variable response of varieties and land configuration to different stresses, a field experiment was planned for evaluating the maize varieties under different land configuration under organic mode in late planting conditions.

Material and methods

The field experiment was conducted at Instructional Farm of College of Agriculture (CAU-I), Kyrdemkulai, Meghalaya (25°74' N latitude, 91°81' E longitude and 700 meter above mean sea level) during *kharif* season of 2020-21 in order to study the effect of land configuration on performance of four maize varieties in late planting condition under organic production system. The experiment was conducted in split plot design involving three land configuration (Flat bed, Furrow irrigated raised bed and ridges and furrow) as main plot and four maize varieties (RCM-76, RCM-75, DA-61-A and RCM 1-2) as sub-plot treatments. All treatments were replicated trice. The climate of selected area is subtropical with average seasonal (June to September) and annual rainfall of 1424.1 mm and 2119.3 mm, respectively.

Table-1 Influence of land configuration on survival and plant height of maize varieties

Treatments	Plant population (No.)			Plant with tassel (No.)		Plant with cobs (No.)		Plant height (cm)		
	30 DAS	60DAS	At Harvest	60 DAS	At Harvest	60 DAS	At harvest	30 DAS	60 DAS	At harvest
Ridges and furrow										
RCM-76	57	44	37	25	28	12	19	104.0	169.3	208.0
RCM-75	55	43	37	24	27	11	18	100.7	163.0	207.0
DA-61-A	58	46	38	28	31	13	21	94.0	161.0	198.0
RCM 1-2	55	41	35	22	25	9	16	92.0	160.0	192.0
Mean	56.3	43.5	36.8	24.8	27.8	11.3	18.5	97.7	163.3	201.3
Furrow irrigated raised bed										
RCM-76	48	41	37	21	25	12	16	101.0	142.7	193.0
RCM-75	48	41	34	19	24	10	16	98.3	138.0	194.3
DA-61-A	51	43	37	25	29	10	19	94.3	135.7	186.7
RCM 1-2	47	40	35	21	22	9	13	90.7	132.3	183.7
Mean	48.5	41.3	35.8	21.5	25.0	10.3	16.0	96.1	137.2	189.4
Flat bed										
RCM-76	47	42	35	26	27	11	18	97.0	135.3	187.3
RCM-75	48	41	34	20	24	8	14	88.7	133.0	177.3
DA-61-A	50	43	37	23	26	9	16	85.7	134.0	170.3
RCM 1-2	45	38	35	21	22	8	13	84.3	132.0	170.7
Mean	47.5	41.0	35.3	22.5	24.8	9.0	15.3	88.9	133.6	176.4
LSD (*P*= 0.05)										
Land Configuration	1.30	1.40	1.56	2.09	1.78	1.26	1.48	2.78	2.80	1.99
Varieties	1.72	1.76	2.25	1.57	1.44	1.72	1.74	3.11	3.19	4.10
Land Configuration × Varieties	2.99	3.05	3.91	2.71	2.49	2.98	3.02	5.39	5.53	7.11

Table-2 Effect of land configuration on dry matter accumulation and partitioning (at harvest) (g/plant) in maize varieties

Treatment	30 DAS	60 DAS	At Harvest					
			Shoot	Root	leaf	Cob	Tassel	Total
Ridges and furrow								
RCM-76	18.7	32.3	21.9	6.1	9.42	55.9	1.99	95.3
RCM-75	18.7	31.7	21.6	6.0	9.40	55.4	1.94	94.3
DA-61-A	17.0	30.0	19.2	5.4	9.02	50.0	1.73	85.3
RCM 1-2	15.0	29.7	19.0	5.3	9.22	49.5	1.67	84.7
Mean	17.4	30.9	20.4	5.7	9.3	52.7	1.8	89.9
Furrow irrigated raised bed								
RCM-76	18.3	29.7	20.2	5.5	9.38	51.6	1.62	88.3
RCM-75	17.3	29.3	19.7	5.4	9.33	50.7	1.55	86.7
DA-61-A	16.0	27.3	18.9	5.2	8.81	48.6	1.45	83.3
RCM 1-2	14.3	25.7	18.5	5.1	9.39	47.9	1.37	82.3
Mean	16.5	28.0	19.3	5.3	9.2	49.7	1.5	85.2
Flat bed								
RCM-76	18.3	27.7	18.6	5.1	9.02	47.9	1.40	82.0
RCM-75	17.3	29.7	18.2	4.9	8.94	46.7	1.36	80.3
DA-61-A	16.7	25.3	17.4	4.7	8.81	44.8	1.27	77.0
RCM 1-2	14.3	25.0	16.8	4.6	8.84	43.8	1.20	75.3
Mean	16.7	26.9	17.8	4.8	8.9	45.8	1.3	78.7
LSD (*P*= 0.05)								
Land Configuration	2.06	2.39	0.32	0.13	0.10	0.72	0.03	1.11
Varieties	0.89	1.94	0.54	0.15	0.27	1.38	0.04	2.38
Land Configuration × Varieties	1.55	3.35	0.93	0.26	0.48	2.40	0.08	4.13

The land cleared off from forest vegetation in 2019 and sown with oat (*Avena sativa*) in *rabi* season of 2019. The field was prepared by giving two pass of power tillers followed by collection of stubbles. After field preparation, ridges and furrow were prepared by keeping 50 cm spacing between centres of ridges; while raised bed were prepared to occupy two rows of maize followed by furrow of 30 cm width and 15 cm depth. For flat bed no any arrangement was made except bund on all side of the plot. The rate of manure application was decided by considering nitrogen requirement of 120 kg/ha as 100 % recommended rate of nitrogen application. The Pongamia cake is used as a source of manure and nitrogen content in it was 2.5 % N. The entire quantity of manure was applied below the seed manually by making a shallow depressing using row maker one day before the sowing. Sowing was done on 24th and 25th June, 2020 by dibbling 1-2 seeds at spacing 50×20 cm in all land configurations. Gap filling was done twice at 10 and 15 DAS. The field was weeded two time 25 and 45 days after sowing (DAS) and no any irrigation was given. For management of fall army worm, cultural practices such as hand picking, application of mud/soil inside whorls in early growth stage and spraying of neem seed kernel extract was done was done. Plant population count was taken at three times at 30 days interval for entire plot; while plants with cob and tassel were counted at 60 DAS and at harvest. Plant height measured by taking height of topmost leaf at 30 and 60 DAS and height of tassel at harvest. Above ground dry matter accumulation was measured by sun drying followed by oven drying at 60 ± 2°C temperature till constant weight achieved. At harvest, dry matter portioning was recorded by measuring the weight of stem, leaf, rot, tassel and cob. The statistical significance among applied treatments were studied using the F-test and least significant difference (LSD) values (P = 0.05).

Results and discussion

Plant survival in different stresses

The survival of plants was affected significantly due to land configuration with highest population in ridges and furrow and found significantly higher than both furrow irrigated raised bed and flatbed planting. At 30 DAS, plant population was higher than expected due to germination of seeds both sown at gap filling and late germination of seed sown at sowing; while mortality of seedling due to picking by bird, eating by insects and uprooting of seedling due to heavy rainfall leads to decrease in plant population. The decrease in plant population was higher from 60 DAS to at harvest and this decrease was 6-8 plant/ha, 4-7 plant/ha and 3-7 plant/ha, respectively for ridges and furrow, furrow irrigated raised bed and flat bed. Out of total plant survived 75.5 % plants produce tassel;

while 50.3 % plant produce cob in case of ridges and furrow; while same for flatbed was 70.3 % plants with tassel; while 43.3 % plant produce cob. Delay in planting, rainfall effect on pollination and fertilization as well as nutrient deficiencies are the possible reasons for non-bearing of cobs. Variation in cob production capacity due to fertility addition was reported by Choudhary and Suresh Kuamr (2013) [9]; while Tian, *et al*., (2019) [10] reported adverse effect excess water stress on different growth stages of maize as well as on grain filling and grain weight. Performance of varieties in terms of their survival and production of tassel and cod differ across land configuration indicated by significance interaction effect between land configuration and varieties. DA-61-A grown in ridges and furrow recorded significantly higher values for plant population at 30 DAS, plants with tassel at 60 DAS and plant with cods both at 60 DAS and at harvest than same variety grown in furrow irrigated raised bed and flat bed; while for other observations on survival it remains on par in all three land configurations.

Growth attributes

The plant height of all maize varieties was highest in ridges and furrow method in all three-land configuration; while among varieties RMC-76 had highest plant height in all three land configuration and found statistically superior to all other varieties at 30 DAS and 60 DAS in ridges and furrow, 60 DAS in furrow irrigated raised bed and 30 DAS and 60 DAS in flat bed planting system. Among land configuration, ridges and furrow had significantly higher plant height at 60 DAS and at harvest; while at 30 DAS, ridges and furrow and furrow irrigated raised bed remain on par with each other. Flatbed planting had lowest plant height and found inferior among all land configuration.

The dry matter partitioning at harvest showed that, cob has highest dry matter accumulation at harvest. The order of significance of dry matter accumulation among different plant part is cob > shoot > leaf > root > tassel with their percent contribution of 58-59, 23, 10-11, 6 and 2 %, respectively. The dry matter accumulation varies between 14.3-18.7, 25.0-32.3 and 75.3-95.3 g/plant at 30 DAS, 60 DAS and at harvest, respectively. The highest dry matter accumulation was recorded in RCM-76 which was significantly higher than DA-61-A and RCM-1-2 at all observations. Among land configuration, ridges and furrow found significantly superior at all observations except, at 30 DAS where all three-land configuration remained on par with each other. Increase in dry matter at in ridges and furrow was 1.1-2.6 g/plant for shoot, 0.4-0.9 g/plant for root, 0.1-0.4 g/plant for leaf, 0.3-0.5 g/plant for tassel and 3.0-6.9 g/plant for cob over other land configuration. Flat bed planting remains on par with furrow irrigated raised bed at 30 DAS and 60 DAS; while at harvest, furrow irrigated raised bed found statistically superior in all plant part including total weight. The superior performance of ridges and furrow was arises due to retention of nutrient applied in close proximity of crop root, prevent washing out of soil and thereby reducing uprooting of seedling, higher forage area for roots to absorb nutrients, safe disposal of water through furrow, ease in weeding operation, reduce direct contact between root and water thereby reducing damage, provide soil to secondary roots and prop root thereby preventing logging due to heavy rainfall and high wind speed and also store moisture. Significance of land configuration in performance of maize was reported [6]; while Wang *et al*., (2020) [11] reported the significance of ridges and furrow in improving the grain yield of maize.

Conclusion

Out study showed that, performance of DA-61-A is superior in terms of survival in late planting condition; while RCM-76 found significantly superior in terms of dry matter production. The RCM planted with ridges and furrow had 15.0 and 20.7 g/plant higher dry matter accumulation at harvest than same variety planted in furrow irrigated raised bed and flat bed planting, respectively. The order of significance of land configuration in influence plant survival and growth was ridges and furrow > furrow irrigated raised bed > flat bed with dry matter production of 89.9, 85.2 and 78.7 g/plant, respectively).

Application research: Fragile ecosystem of North East Hill (NEH) Region and quantification of dry matter partitioning and crop establishment in late planting condition as affected by land configuration in high rainfall area.

Research category: Agronomy (Crop production)

Acknowledgement / Funding: Authors are thankful to Department of Agronomy, College of Agriculture, Kyrdem Kulai, 793105, Meghalaya, Central Agricultural University, Imphal, 795004, Manipur, India for research funding

****Principal Investigator or Chairperson of research: A. A. Shahane**
University: Central Agricultural University, Imphal, 795004, Manipur, India
Research project name or number: Research station study

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Instructional Farm of College of Agriculture (CAU-I), Kyrdemkulai, Meghalaya

Cultivar / Variety / Breed name: Maize (*Zea mays*)

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

References

[1] Directorate of Economics & Statistics, Government of Meghalaya (2019) *Handbook on area, production and yield of principal crops in Meghalaya, 2019 (including land use statistics and irrigation statistics), Directorate of Economics and Statistics, Government of Meghalaya, India*

[2] Guhathakurta P., Bhagwat P.P., Satpute U.S., Menon P., Prasad A.K., Sable S.T., Advani S.C. (2020) *Observed Rainfall Variability and Changes over Meghalaya State. Met Monograph No.: ESSO/IMD/HS/Rainfall Variability/17(2020)/41.*

[3] Singh A.K., Ngachan S.V., Munda G.C., Mohapatra K.P., Choudhury B.U., Anup Das, Srinivasa Rao Ch., Patel D.P., Rajkhowa D.J., Ramkrushna G.I., Panwar A.S. (2012) *Carbon Management in Agriculture for Mitigating Greenhouse Effect. ICAR Research Complex for NEH Region, Umiam-793 103, Meghalaya, India*, 70-82

[4] Prokop P. (2014) *The Meghalaya plateau: Landscapes in the abode of the clouds In: Landscape and landforms of India (Kale V.S. Edn). World Geomorphological Landscapes, Springer Science Business Media Dordrecht*

[5] Choudhary V.K. (2016) *Agronomy Journal*, 108(5), 2147-2157.

[6] Halli H.M., Angadi S.S. (2019) *Journal of Farm Science*, 32(4), 397-402.

[7] Layek J., Ramkrushna G.I., Suting D., Ngamgom B., Krishnappa R., De U., Das A. (2016) *Indian Journal of Hill Farming*, 29(2), 124-129.

[8] Ramkrushna G.I., Das A., Layek J., Babu S., Verma B.C., Patel D.P., Krishnappa R., Savita S., Ngachan S.V. (2018) *Indian Journal of Agricultural Sciences*, 88(5), 766–770.

[9] Choudhary V.K., Suresh Kumar P. (2013) *International Journal of Plant Production*, 7(2), 167-186.

[10] Tian L., Bi W., Liu X., Sun L., Li J. (2019) *Acta Physiologiae Plantarum*, 41, 63.

[11] Wang Y., Guo T., Qi L., Zeng H., Liang Y., Wei S., Gao F., Wang L., Zhang R. and Jia Z. (2020) *Agricultural Water Management*, 234, 106144.