WORLD ENVIRONMENTAL CONSERVATION CONFERENCE
2023

CLIMATE CHANGE PARTNERSHIP ACTIONS FOR SUSTAINABLE FUTURE AND RESTORING LIFE ON EARTH

Proceedings of the 6th edition of World Environmental Conservation Conference

18th – 21st October, 2023

EDITIORS: Agele, S. O. (PhD), Balogun, I. A. (PhD), Oluleye, A. (PhD) and Oladeji S. O. (PhD)

Production of Proceedings
Netlink Environmental Conservation Organisation
Room 21 Abubakar Adamu Bulding
Federal University of Technology, Akure.
Design amd Printing of Proceedings
Maryj Printing Press
ACAD Fagbote Filling Station Akure-Ilesha Expressway
Phone number: +23407063411658

Copies of Proceedings
Dr. S. O. Oladeji
President, Netlink Environmental Conservation Organisation (NECOR),
Room 21 Abubakar Adamu Building
Federal University of Technology, Akure.
P. M. b. 704, Akure, Nigeria
E-mail: sooladeji@fita.edu.ng.
sooladeji@necorng.org
info@necorg.org.
www.mecorng.org.
ISSN: 2705-2850

Scientific Review Committee

Prof. S. O. Agele- Chairman Scientific Committee
Department of Crop, Soil and Pest Management, FUTA
+2348035784751
soagele@futa.edu.ng

Prof. I. A. Balogun
Department of Meteorology,
Federal University of Technology,
Akure.
iabalogun@futa.edu.ng.

Prof. A. Oluleye
Department of Meteorology,
Federal University of Technology,
Akure.
aoluleye@futa.edu.ng.

Dr. S.O. Oladeji
Department of Ecotourism and Wildlife Management, FUTA.
Executive Director, NECOR
+2348030698896
sooladeji@futaedu.ng.
sooladeji@necorng.org

PREFACE

There is a growing concern on the adverse impacts of climate on biodiversity. This phenomenon is greatly manifested in form of shifting weather patterns threatening global food security, health and species existence. Humanity is at the receiving end of the consequences of climate change hence there is a need to step up actions on all fronts- overtime, everywhere all at once.

This calls for collaboration, partnership and networking to strengthening synergy among relevant stakeholders in a bid to tackling climate change menace. This forms the basis for the theme of this year world Environmental conservation conference: **CLIMATE CHANGE PARTNERSHIP ACTIONS FOR SUSTAINABLE FUTURE AND RESTORING LIFE ON EARTH.** The theme is conceived with a view to create an interface for information sharing and offer opportunities for participants to refine their commitments and pledges in the quest to achieving Sustainability in the face of climate change.

This year World Environmental Conservation Conference is memorable in the sense that it received overwhelming funding from the host - West African Science Service on Climate Change and Adapted Land use). WASCAL is posed to provide information and knowledge at the local, national and regional level to cope with the adverse impacts of climate change. Thus, this conference will offer opportunities for participants to learn from good practices demonstrated and showcase by WASCAL during the course of the conference. It will also strengthen staff-student exchange and provide prospect for Doctorate Research Doctoral Research in West Africa Climate System Programme (DRP WACS) – WASCAL among others.

Special appreciation goes to the management of The Federal University of Technology, Akure the host institution, National Park Service and African Regional Center for Space Science and Technology Education-English (ARCSSTE-E) that co-host this conference. We equally acknowledge other private, individual and corporate organizations that have contributed towards the success recorded in this event.

All the submitted articles were subjected to strict double blind peer-review process by the reviewers that are experts in the area of the particular submitted manuscript. The accepted manuscripts are published in WECC 2023 proceedings and also available for download on the organization website (www.necorng.org).

The accepted manuscripts fall within the underlisted subthemes:

- Climate change adaptation strategies in Agriculture, Forestry and Other Land Use (AFOLU)
- Climate smart city and architectural landscape design
- Retrofitting and decarbonization in tourism and hospitality industry
- Indigenous knowledge and local innovation in climate change adaptation
- Climate risk management, health, safety and hygiene
- Carbon credit-offset marketing/circular economy
- ICT development in environmental conservation (image processing and acquisition, computer vision, graphics, speed, interface technology, HMD devices, GIS: Body Tracking, AI and IOT, VRT, IVE).

We commend our keynote speaker Prof. Douda Kone Director Capacity Building Department, WASCAL Headquarter, Ghana and other guest speakers Prof. Babatunde Rabiu, Director General, Chief Executive Office, African Regional Centre for Space Science and Technology Education-English (ARCSSTE-E) and Dr. Goni I. M., Conservator General National Park Service.

It is hoped that researchers, students and policy makers will find the papers in this book very useful. Even though all the papers were reviewed and edited, the content and option expressed remain essentially that of the authors and not necessarily that of Netlink Environmental Conservation Organization.

Dr. Oladeji S. O.

President Netlink Environmental Conservation Organization

Convener World Environmental Conservation Conference

TABLE OF CONTENT

MONITORING SOWING SEASONS AND WINDOWS FOR SUSTAINABLE SWEET PEPPER PRODUCTION IN OKITIPUPA COASTAL AGROECOLOGY

Titilayo O. Oladitan

Dept of Crop, Soil and Pest Management Olusegun Agagu University of Science and Technology Okitipupa, State Nigeria. Email: ditanbimpe@gmail.com*; Tel: 08060485319*

ABSTRACT

Vegetables are the best resource for overcoming micronutrient deficiencies and provide smallholder farmers with more income and jobs per hectare than staple crops. In coastal environments, soil and weather factors limit their production in humid conditions. Studies of crop-weather relationships are necessary to assess the effects of the occurrence of extreme weather events on vegetable crop performance. Thus, a study was designed to assess the influence of sowing dates and seasons on the growth and yield performance of sweet pepper for year-round production and its contribution to food security. Seedlings of improved sweet pepper were sown at four sowing dates: SD1:5-Mar; SD2:12-Mar; SD3:19-Mar & 26-Mar (early cropping season) and SD1:Aug1; SD2:8-Aug; SD3:15-Aug; & SD4:22-Aug (late season cropping), laid in a RCBD replicated thrice using a 45 x 60 cm spacing for both seasons. The crop was raised by adopting standard cultural practices. Phenological and yield parameters were collected. Seasonal variations in yield were related to cumulative rainfall, rainy days, onset and cessation dates of rainfall, and duration of the growing season for statistical analysis. The results showed that growth, fruit yields, and availability can be explained by combinations of weather parameters during the sowing seasons. Soil and weather conditions are critical factors and important determinants of the growth and yield of pepper. Development of agronomic, technological, and environmental interventions to alleviate soil and weather-driven constraints on crop productivity in coastal areas Optimum sowing dates ensure proper growth and development of plants, resulting in maximum crop yield and economic use of land.

Keywords: *Green Pepper, Growth, Yield, Sowing Date, Sowing Season, Sustainable Agriculture*

INTRODUCTION

The production of economic vegetable crops to attain good food security and livelihood sustenance has a direct relationship with environmental and management strategies. In the humid tropics, the rainy (wet) and late (dry) sowing seasons are associated with changes in climatic attributes. This contributes to and, to a greater extent, influences crop productivity because it determines the sowing windows. (Agele, 2010). Sowing date is an important management factor of production for all crops, especially in regions where the growing seasons are determined primarily by microecological climatic variability (McKay *et al.,* 1992; Mahmud et al., 2017). The selection of appropriate sowing dates and cultivars is one of the most important requirements in farming to obtain good quality and maximum yield. Sowing date influences crop vegetative and reproductive phases, yield, and yield quality (Islam, 2010). Appropriate sowing dates are necessary to control the damage caused by environmental and climatic factors (cold, heat, pests, diseases, and weeds, among others) (Akinseye et al., 2022). The effect of the sowing date on the growth and yield of some crops heavily depends on climate conditions and the type of cultivar known. Earlier sowing results in a longer period of growth and a higher yield, but crops may be faced with the challenges of competing with weeds, rainfall patterns, temperature fluctuations, and infestations of pests and diseases (Lopez-Bellido *et al.,* 1994). Changing and/or adjusting the sowing date could assist in overcoming the adverse effects of environmental stress and also in avoiding stress in critical stages of plant growth (Caliskan et al., 2008). Oladitan (2021) concluded that environmental factors have a great influence on the growth and yield of crops. Time to flowering and duration of growth strongly influence the climatic adaptation and yield potential of a crop. Oladitan (2018) compared different sowing dates for tomato and expressed that delay in sowing significantly prolonged vegetative growth and reduced fruit yield, both in quantity and quantity; however, prolongation of the harvesting period is important for food security. Ebrahimi *et al.* (2013) evaluated the effect of sowing dates on canola in Canada and concluded that late planting delays maturity and yield. This finding agrees with the study of Mandal *et al.* (1994). Patrick and Darcy (2006) reported that sowing date had a significant effect on plant height, number of nodes per plant, number of flowers, and yield of tomato. The determination of the optimum sowing date in a growing season is therefore considered an important effort to have optimum quantitative and qualitative yields. In general, the delay in planting after the optimum time resulted in a potential crop yield reduction, while the proper sowing date is an important factor for obtaining optimum growth and yield components. (Oladitan, 2017).

Sweet pepper, green bell pepper (*Capsicum annuum L. var. gross Sendt.)* Solanaceae is a delicious culinary vegetable fruit with a highly nutritive and medicinal value. It is a powerful antioxidant and contains vitamins A, B (B6 and B9), and C, which are inflammatory. Regular consumption is useful in combating aging. Research reports show that green pepper cultivation is still under small-scale cultivation in southwest Nigeria, where consumption is relatively higher than the rate of cultivation as a result of everincreasing population and industrialization utilization. The restriction in production is due to weather conditions, soil status, and good agronomic practices, among other factors. Considering this crop of high nutritive and economic value, efforts must be made to improve and increase productivity in the rainforest agroecology environment. The present status of scientific knowledge aligned with monitoring the effects of climatic factors, soil and crop cultural management practices such as fertilizer application, and estimating the planting dates and season of sowing, among others, could assist in enhancing the productivity of the crop. Therefore, this study was designed to monitor sowing seasons and sowing dates and the influence of weather factors on the growth and yield of green sweet pepper (green sweet pepper), the possibility of its continuous production, and its contribution to food security in Okitipupa, a coastal ecology in the southwest of Nigeria.

MATERIALS AND METHODS

Experimental Site

The study was carried out at the Teaching and Research Farm of Olusegun Agagu University of Science and Technology, Okitipupa, during the 2020–2021 cropping session. The area lies approximately within latitude 06°25' N and 06°25' N and longitude 04°35' E and 04°50' E within the rainforest coastal zone of south-west Nigeria. Temperatures show a slight variation throughout the years, with average monthly minimum and maximum temperatures of 21 °C and 34.2 °C and a mean monthly temperature range of 27° to 28°C. Okitipupa has a bimodal rainfall pattern, with the first season commencing from March to July with a dry spell in August, followed by the second season from September to November, while annual rainfall exceeds 2000mm. The area has two distinct geological formations: the pre-cambium basement complex granitic rocks in the northern part and the recent to tertiary sandy sediments with elevations less than 300m above sea level. The soil was clay loam (28.8%, 24%, and 47.2% sand, silt, and clay, respectively) in texture and slightly acidic in reaction (pH 5.1). The initial soil organic carbon was 1.67%, total N was 0.14%, and available P and K contents were 2.12 mg/kg and 0.07 cmol/kg, respectively.

Treatments and Design

Sweet pepper (green) (Var California Wonder) seeds obtained from the pioneer seeds were nursed and transplanted into the field at 5 WAS. Four sowing dates: SD1:5-Mar; SD2:12-Mar; SD3:19-Mar & 26-Mar (early cropping season) and SD1:Aug1; SD2:8-Aug; SD3:15-Aug & SD4:22-Aug (late season cropping) were selected within the sowing period for the experiment both in wet and dry cropping seasons. This was laid out in a randomized complete block design (RCBD) replicated three times. A planting distance of 45 x 60 cm was maintained for both seasons on 3 x 3 m plots to give a planting population of 13,333 ha. Recommended farmyard manure (15 t/ha) was applied three weeks before transplanting and for the recommended inorganic fertilizers (120: 60: 60 kg NPK/ha). The crop was raised by adopting standard cultural practices.

Data Collection

Six plants were selected randomly from each unit plot for data collection. Data were recorded from sample plants during the period of the experiment. An observation was recorded for plant height, number of leaves per plant, leaf area, days to 50% flowering, days to first harvesting, number of fruits per plant, fruit weight, and fruit yield. The growth and yield parameters that were determined were then subjected to analysis of variance (ANOVA) using the SAS statistical package. Means found to be statistically significant ($P \leq 0.05$) were separated using Fisher's Least Significant Difference (FLSD).

RESULTS AND DISCUSSION

Climatic condition

Table 1 shows the mean climatic condition of the study site between the years 2020 and 2021 to cover the experimental years. The maximum mean temperature is in a range of 26°C–30°C and a mean of 28°C, while the minimum temperature is between 21°C and 23°C, with the mean at 22°C. There is slight variation in the temperature range throughout the seasons of cropping. The rainfall gradually rises from February with a value of 111.71 mm to its peak in July at a value of 380.2 mm. A drop occurs in August to give the August break, and the second peak occurs by September to early November with a mean annual rainfall volume of 119.4 mm to 256.2 mm. This marks the beginning of the dry season. The study area is characterized by 3–4 months of dryness, usually from December to early March. The rainy months are characterized by high relative humidity (>70%). The solar radiation is evenly distributed throughout the year except for late July to August, when the rainfall ceases, "August Break", At the peak of the dry season, the atmosphere is clear, thus the radiation is high, and at least when the rainfall is at its peak value.

Table 1 Weather data for the 2020 and 2021

	Month	J	F	M	A	M	J	J	A	S	O	N	D
	Rainfall	0.0	0.0	111.7	242.5	155.3	380.2	151.1	57.1	340.1	143.0	175.9	17.5
	Radn	19.4	18.6	17.6	18.8	18.6	16.7	14.6	15.4	13.9	17.4	19.2	18.1
	T_max	29.6	31.0	30.0	29.5	29.0	28.0	27.1	27.8	27.5	28.8	29.6	29.8
	T_min	18.1	20.3	23.6	23.6	23.4	22.6	21.7	20.6	21.8	22.2	22.2	21.8
	RH%	70.2	75.1	89.3	89.7	91.1	92.3	92.5	89.3	92.1	90.2	85.9	86.0
2020	Wind_2m	0.8	0.7	0.6	0.6	0.5	0.6	0.7	0.8	0.6	0.5	0.5	0.5
	Rainfall	5.8	23.1	84.6	255.4	150.7	432.1	81.6	284.0	325.3	182.2	46.5	5.5
	Radn	18.4	18.2	16.9	19.6	18.2	16.9	14.6	13.5	16.1	17.9	18.3	17.7
	T_max	30.4	30.7	29.8	29.3	28.6	28.2	27.8	27.2	27.7	28.4	29.1	29.3
	T_min	21.3	21.8	23.2	23.4	23.3	22.6	21.8	22.0	22.2	22.8	23.0	20.7
	RH%	81.8	82.2	88.8	90.4	91.7	91.4	91.2	92.9	92.1	91.8	90.6	82.6
2021	Wind_2m	0.5	0.6	0.6	0.6	0.6	0.5	0.7	0.6	0.6	0.5	0.4	0.5

Crop Growth and Development

Statistical analysis of the data indicated that there were significant differences among the different sowing dates and also among the cultivars for various parameters recorded during 2020 and 2021.

Table 2: Effect of planting date on plant height(cm) and leaf weight(kg) of pepper cultivar

Early cropping season							Late cropping season					
WAT	2	4	6	8	10	12	2	4	6	8	10	12
NO OF LEAVES												
SD1	45.1d	57.5d	111.8b	201.7d	260.1d	170d	44.4a	114.7a	187.4a	214.7a	305.9a	200a
SD2	45.3c	58.5c	113.2ab	204.5c	263.3c	173c	43.3a	110.0a	176.4b	201.5b	281.5b	182b
SD3	46.9b	60.3b	118ab	212ab	273.5b	179b	41.9b	101.7b	157.5c	204.2c	248.0c	153c
SD4	48.2a	61.9a	120.9a	218.5a	281.5a	184a	41.5c	94.6c	137.5d	192.8d	228.7d	139d
PLANT HEIGHT (cm)												
SD1	15.9d	23.8b	34.5c	40.2c	47.8d	56.0c	12.5c	17.8d	24.3d	32.7d	40.6c	47.8c
SD2	17.2c	24.6b	36.2c	41.8c	50.1c	61.5b	12.9c	19.1c	25.2c	34.9c	43.7b	51.1b
SD3	19.8a	26.3a	37.9ab	43.1b	53.7b	64.5a	13.6b	21.7a	28.7a	35.9b	45.4a	54.5a
SD4	18.4b	26.5a	39.5a	44.4a	57.3a	64.3a	14a	20.3b	27.4b	36.4a	44.1b	54.3a

Means with similar alphabet along the column and within same treatment are not significantly different P<0.05 (DMRT)*significant, significant at P<0.01,WAT =Weeks after transplanting, SD =Sowing date (SD1:5-March; SD2:12-March;SD3:19-March;SD4:26-March. Late cropping season-SD1:Aug1:SD2:Aug-8;SD3:Aug15;SD4:Aug-22)

Table 3: Effect of planting date on selected yield parameters

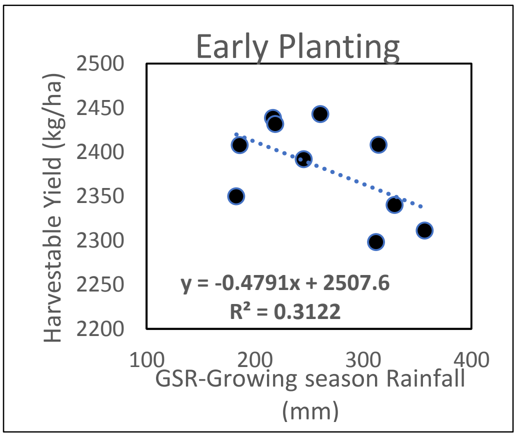
	Early Cropping				Late season cropping			
	50% Anthesis Day	Fruit no/m2	Harvested wt.(kg/ha)	Mkt fruits wt.(Kg/ha)	50% Anthesis Day	Fruit no/m2	Harvested wt.(kg/ha)	Mkt fruits wt.(Kg/ha)
SD1	20.8b	57.65c	2358.8d	2189d	20.59b	37.70d	2349.9d	2119d
SD2	21.78a	58.26c	2407.6c	2322c	20.61b	54.60c	2398.9c	2202c
SD3	21.79a	58.35ab		2423b	20.79b	68.40b	2424.0b	2283b
SD4	21.87a	59.59a	2480.83a	2452a	21.70a	72.50a	2472.3a	2361a

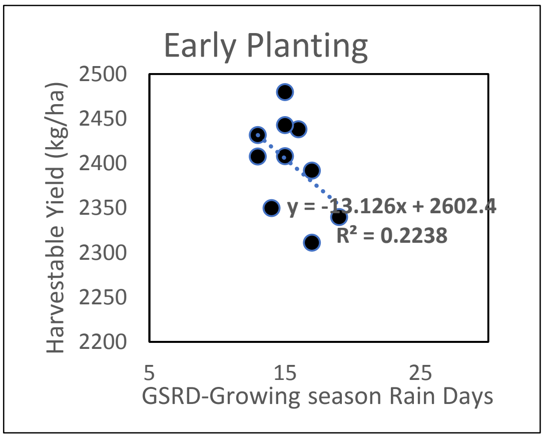
Means with similar alphabet along the column and within the same treatment are not significantly different P<0.05 (DMRT) *significant, significant at P<0.01, WAT =Weeks after transplanting, SD =Sowing date (SD1:5-March; SD2:12-March; SD3:19-March, SD4:26-March. Late cropping season-SD1: Aug

The effects of sowing dates on the plant height (cm) and the leaf number of sweet pepper sown during the early and late cropping seasons were measured between 2 and 12 WAS (Table 2). A significant difference was noted for leaf number as the weeks of measurement progressed, recording the maximum number of leaves from SD4 (184) while SD1 (170) had the minimum for early cropping. Late cropping season followed a reversed pattern in the observed measurement, recording the maximum number and height on SD1 (200), and SD4 (139) had the least weight. The same trend was observed for plant height in the early cropping season; SD4 at 12WAT recorded 64.3cm, while SD1 recorded 56.0cm for early season cropping and 53.3 and 47.8 cm for SD4 and SD1 in late season cropping, respectively, showing significant differences in the measurement for the evaluation.

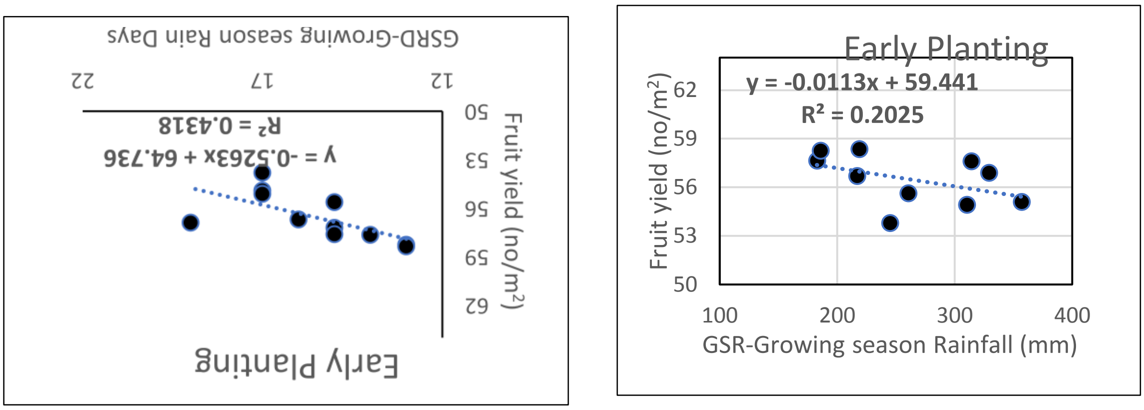
The increase in number of leaves and increase in plant height at SD4 in early-season cropping and SD1 in late-season cropping could be a result of climatic conditions during the period. The moisture level in the soil at field capacity is relatively adequate for plant utilization, and it easily releases nutrients to the crop. Adequate moisture content in the soil improves the vegetative growth of the crop. It tallies with the reports of Ayankojo and Morgan (2020); Agele et al. (2011) on the water use efficiency of Tomato, and Olasotan (2001) on okra. The effects of different sowing dates on yield performance are displayed in Table 3. Day to Anthesis was statistically different but not significant among the sowing dates, except SD1 in the early cropping system and SD4 in the late cropping season. This implies that the days to anthesis were genetically determined and could be slightly influenced by environmental conditions. (Oladitan et al., 2014; Sagar Koner et al., 2015). Fruit no/m2 (wet matter) significantly differs in both seasons of cropping. Late-season cropping recorded higher numerical numbers than early-season cropping. SD4 in both seasons recorded the highest numerical values (72.50 and 59.59), respectively, for late-season and early-season cropping and were significantly different from SD2, while SD1 had the lowest values. The harvested weight (kg/ha) and market fruit weight (kg/ha) follow the same pattern, with SD4 being the most productive sowing window for the study area in both seasons. The harvested fruit weight at early-season cropping (2480.8kg) was higher than at late-season cropping (2472.3kg), but the difference was significantly higher at the sowing date (table 4). The highest average fruit weight was found from plants in SD4, and the minimum harvest was recorded at SD1 for both planting seasons. The significant differences in both cropping seasons followed the same trend. The increase in yield components with the SD4 planting date may be attributed to the availability of favorable environmental conditions (Fig. 1) for appropriate synchronization of flowering and subsequent transformation to fruits for producing optimum yield (Nahardani et al., 2013). However, the results are in contrast to the finding of Alam et al. (2011), who recorded the highest fruit yield of sweet pepper (19.36 t/ha) under an early planting date. Oxley and Rivard (2014) also registered the highest yield under early planting of bell pepper varieties. Reduction in fruit number in early cropping may be associated with decreased concentrations of reducing sugars in flower buds and flowers, which may result in failure of pollination and induce abscission of flowers under high rainfall conditions (Koner et al., 2015). Taskovics et al. (2010) also pointed out that under heavy rainfall and high humidity conditions, fruit set becomes poor and less developed fruits are produced.

Seasonal variation in yield parameters in relation to rain day and growth season rainfall.





(a) (b)



© (d)

Fig 2(a-d): Seasonal variation in fruit number/m2 in relation to the rainy days and growth season rainfall.(P<0.05;GSR-Growth sowing rain).

The harvestable yield was affected by about 30% of the rainfall during the growing season, and it is inversely proportional to the rainy days. The trendline gradient is negative and low (0.3122). The regression shows that rainfall above 300mm is detrimental to the harvestable yield of sweet pepper. The higher the amount of rainfall, the lower the harvestable yield. The harvestable yield of GSD is hyperbolic. The regression index is poor (0.02). Rainfall contributes about 20% of the factors affecting the harvestable yield during early-season planting. It shows that rainfall during the growing season affects the rate of flower dropping, and with high relative humidity, it leads to fruit rotting.

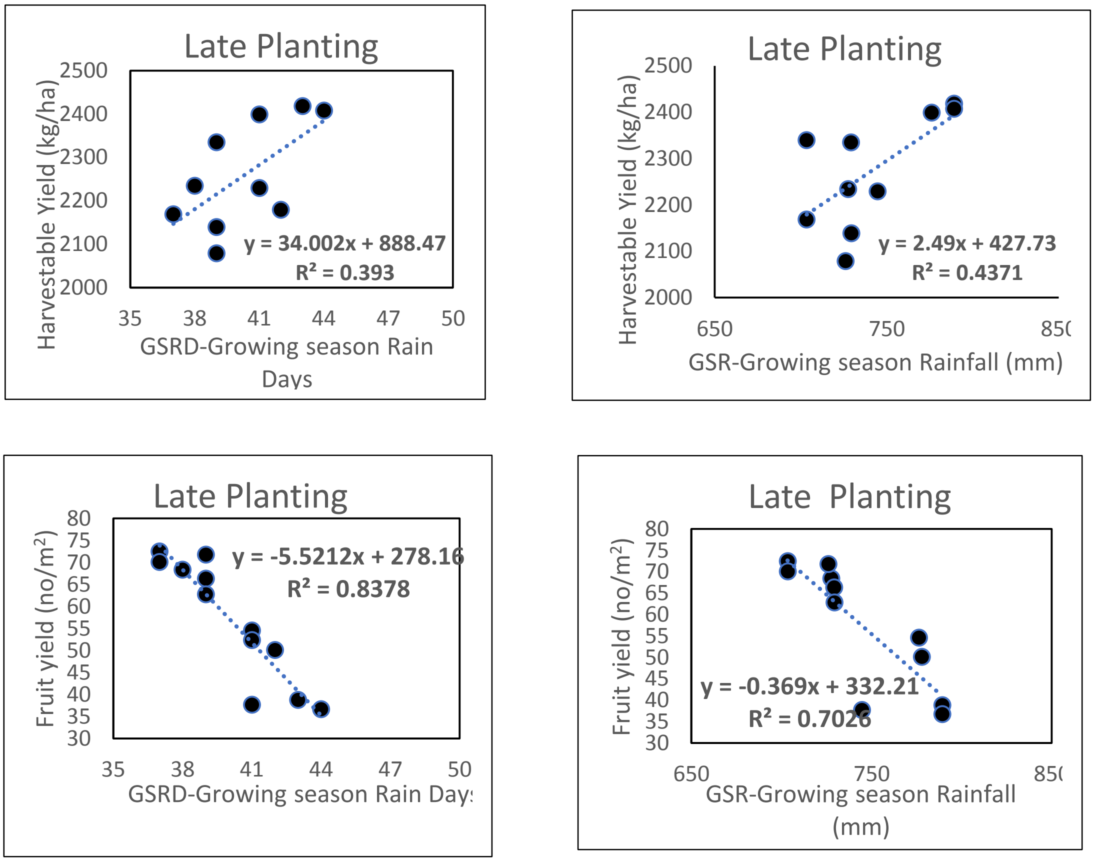


Fig 3: Seasonal variation in fruit number/m2 in relation to the rainy days and growthseasonrainfall. (P<0.05; GSR-Growth sowing rain).

Harvested yield increases with the increase in GSRD (Fig. 3a), given that the regression index is fair (0.4) and the gradient index is positive.

The harvest yield (kg/ha) is influenced by about 40% of the rainfall during the growing season. The number of rainy days can explain the yield. Rain days beyond day 44 could be detrimental to the yield of sweet pepper. Fruit yield (no/m2) (Fig. 3b) has a very strong relationship with the GSRD (R^2=0.84). The rainy day has above 83% influence on the number of fruits produced per meter square. The trendline of 5.5, though negative, influences the fruit number. Rain days beyond day 44 may be detrimental to the fruit yield. It confirms that fruiting is encouraged by early planting in the late season.GSR (Fig. 3b) contributes about 44% to the harvestable yield in late-season planting. The trend gradient is positive (2.4). As the growing seasonal rainfall increases, the yield also increases; however, if GSR is beyond 800mm, it could lead to a decrease in harvestable yield. GRS (mm) (Fig. 3d) on fruit yield has a strong correlation. The regression values show a 70% influence on the fruit yield. The bulk of the fruit was produced at a GSR range of 700–800 mm. Below 700mm may reduce the fruit number as a result of water stress, and above 800mm GSR may lead to logging and pest infestation. (Akinseye et al., 2022). The correlation between harvested weight was strong R=0.588, indicating that rainfall is a factor in continuous production; similarly, for a late-season experiment, the value of r = 0.57. The same trend goes for the correlation between the number of rainy days and harvestable yield (95% L.S.). There was a strong correlation for both seasons, but it was higher in the dry season.

CONCLUSION

The importance of integrating knowledge of management practices to estimate crop growth and yield information is useful in predicting future production levels and planning responses to future climate change. Sowing dates is one of the most important aspects of the production systems of different crops. Optimum sowing or planting time ensures proper growth and development of plants, resulting in maximum crop yield and economic use of land. Significant ($P<0.05$) differences were observed for pepper parameters in the early and late sowing seasons (planting dates).The rainy season weather conditions were most favorable, having optimum growth, leaf development, and fruit yield compared with the late season, which had lower vegetative but higher reproductive performance in terms of fruit weight.The interaction of season and planting dates was highly significant for plant height, fruit weight per plant, fruit yield, and the number of fruits per plant.

REFERENCES

Agele, S.O., Iremiren, G.O., Ojeniyi, S.O. 2011. Evapotranspiration, wáter use efficiency and yield of rainfed and irrigated tomato in the dry season in a humid rainforest zone of Nigeria. International Journal of Biology & Agricultural Sciences 13, 469-476.

Akinseye, S.O. Agele, P.C.S. Traore, M. Adam, A.M. Whitbread, Evaluation of the onset and length of growing season to define planting date - 'a case study for Mali (West Africa)' Theor. Appl. Climatol., 124 (2016) 973–983. DOI 10.1007/s00704-015- 1460

Alam.M.S. Salsa., M. Aalam M.S and Alam. M.K (2011) Effects of Sowing time and plant spacing on the yield and yield attributes of sweet pepper. Bangladesh Journal of Agricultural Research,36(1):271-278.

Ali M.B, Hamma I.L., Wakili A., and Yusuf S., 2014, Performance of tomato as influenced by organic manure and sowing date in Samaru, Zaria.International

Etissa E., Dechassa N., Alamirew T., Alemayehu Y., and Desalegn L., 2013, Growth and Yield Components of Tomato as Influenced by Nitrogen and

FAOSTAT. 2018. Data on harvested area. production volume and yields of tomato worldwide Data available at: http//www.fao.org/faostat/en/#home (accessed from January 2016).

Food and Agriculture Organization (FAO) Yearbook Production 2003. 13. Rome: FAO.

Food and Agriculture Organization of the United Nations. FAO (2012). Tomato Production statistic. faostat.fao.org.

Ghimire S., Shant M.S., Arbind S., 2013, Sweet pepper production using different nitrogen sources in subtropical climate. Journal of agriculture and food science Vol1(1), pp6-10

Hamma I.L., Ibrahim U., and Haruna M., 2012, Effect of Planting date and Spacing on the Growth and Yield of Sweet Pepper (Capsicum Annuum L.) in Samaru area of Zaria in Nigeria. Nigerian Journal of Agriculture, Food and Environment. 8(1): 63-66

Hassan S.A., Gerber J.M., and Splittstoesser W.E., 1993, Growth and yield potential of green pepper as affected by nitrogen at transplanting. Pertanika J. Trop, Agric. Sci., 16(2):101-105

Ilupeju E., Akanbi W., Olaniyi J., Lawal B., Ojo M., and Akintokun P., 2015, Impact of organic and inorganic fertilizers on growth,fruit yield, nutritional and lycopene contents of three varieties of tomato (Lycopersicon esculentum (L.) Mill) in Ogbomoso, Nigeria 2015: African Journal of Biotechnology

Islam M., Saha S., Akand H., and Rahim A., 2010, Efffect of sowing date on the growth and yield of sweet pepper (Capsicum annuum L.) AgronomskiGlasnik 1/2010

Journal of Agronomy and Agricultural Research (IJAAR).Vol. 5, No. 5, p. 104-110, 2014

Mahmud, N.U., Chakma, R., Ahmed, N.U., MAU ZamanM.A.U., A Hossain, A. 2017. Effect of sowing date on quality seed production of sweet pepper in Bangladesh. Progressive Agriculture 28 (3): 216-221, 2017 ISSN: 1017 – 8139.

Mehdizadeh, E.I. Darbandi, H. Naseri-Rad, H. Tobeh, Growth and yield of tomato (Lycopersicon esculentum Mill.) as influenced by different organic fertilizers. Intl J. Agron Plant Prod 4 (2013) 734-738.

Oladitan 2017 growth and development of gp as influenced by by planting dates and fertilizer application in Owo, south west Nigeria. International journal of horticulture, 7(29):262-274 (doi:10.5376/ijh.2017.07.0029)

Oladitan T.O and Akinseye F.M 2014.Influence of Weather Elements On Phenological Stages and Yield Components of Tomato Varieties in Forest Ecological Zones of Rainforest. Journal of Natural Sciences Research, Vol 4, No 12.

Oladitan, K.O. Oluwasemire, Influence of weather condition on selected tomato varieties in response to season of sowing in Akure, a rainforest zone of Nigeria. Art Human Open Account Journal. 2 (2018) (6) 422–426. DOI: 10.15406/ahoaj.2018.02.00092.

Olasantan F.O (2001) Optimum Plant Populations for Okra in a mixture with Cassava (Manihot esculenta) and its Relevant to Rainy Season-Based Cropping Systems in south -western Nigeria. The Journal of Agricultural Science,136, 207-214

Oxley, K. L. and Rivard, C. L. (2015) 2014 Evaluation of determinate tomato varieties for high tunnel production in Kansas, Midwest Vegetable Trial Report for 2014. W. Lafayette, Indiana: Dept. of Horticulture and Landscape Architecture, Office of Agricultural Research Programs, Purdue University.

Sagar Koner, Ranjit Chatterjee and Suchand Datta (2015) Effect of planting dates and varieties on growth, fruit yield, and quality of bell pepper (Capsicum annuum L.) Journal of Applied and Natural Science 7 (2): 734 -738 (2015)

Shalaby, G. El-Banna, Molecular and Horticultural Characteristics of In vitro induced Tomato Mutants. J. Agric. Sci. 5 (2013) 155-163, http://dx.doi.org/10.5539/jas.v5nl0p155. [5]