



**PRODUCTIVITY OF
HABANERO PEPPER
(*Capsicum chinense* L.)
VARIETY TO VARYING
LEVEL OF FARMYARD MANURE,
WEED CONTROL AND INTRA ROW
SPACING IN NORTHERN GUINEA
SAVANNAH**

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Abstract

Field trials were conducted during the 2016 wet seasons at the experimental site of Kaduna Agricultural Development Agency (KADA) sub-station located in Maigana, Soba

Local Government Area and the research farm of the Institute for Agricultural Research (IAR) Ahmadu Bello University Zaria in the

Key Words:

Farmyard manure, weed control, intra-row spacing and habanero pepper *Capsicum chinense* L.

Northern Guinea Savanna Ecological Zone of Nigeria to assess the performance of Habanero pepper in response to farmyard manure, weed control method and intra-row spacing. The treatments consisted of three farm yard manure rates at (0, 10, and 15 t ha⁻¹), six weed control treatments which include pre-transplant application of 1.5 and 2.0 kg a.i pendimethalin ha⁻¹ and post-transplant

application of 1.5 and 2.0 kg a.i pendimethalin ha⁻¹, hoe weeding at 6, 9 and 12 WAT and weedy check and two intra-row spacing at 20 and 40 cm. A split-plot design was used in which a factorial combination of farmyard manure was assigned to the sub-plot while weed control method and intra-row spacing were assigned to the main plot, the treatments were replicated three times. The results from the study revealed that 15 t ha⁻¹ FYM produced higher crop vigour score, more number of leaves, number of fruit per plant, fresh fruit weight per plant and fresh fruit yield per hectare while days to 50% flowering was significantly reduced compared to 10 t ha⁻¹ FYM and the control. The hoe weeded control consistently gave significantly higher crop vigour score, more number of leaves, number of fruit per plant, fresh fruit weight per plant and fresh fruit yield per hectare while days to 50% flowering was significantly reduced compared to the application of 1.5 and 2.0 kg a.i ha⁻¹ pendimethalin at pre transplant and post transplanting and weedy check. The weedy check caused significantly lower

crop growth, yield and yield components compared to other treatments throughout the sampling period in both locations and seasons. The 40 cm intra row spacing significantly produced higher crop vigour score, crop growth and yield characters. The result obtained from this study revealed that 15 t ha⁻¹ FYM, hoe weeding at 6, 9 and 12 WAT and 40cm intra row spacing resulted in highest fresh fruit yield and therefore can be adopted by the habanero pepper farmers in the Northern guinea savanna ecological zone.

Introduction

Habanero pepper (*Capsicum chinense* L.) belongs to a group of hot pepper popularly called atarodo or tarugu in Nigeria. Most often scientists mistakenly classify the habaneros as members of sweet pepper group. It is believed to have originated from Cuba (De Witt and Gerlach, 1964). It is a tropical crop which can also be grown in the subtropical environments and it can grow on a wide range of altitudes, with rainfall between 600-1250mm. In recent years, the habanero pepper has become increasingly important as a result of its high diversity and high fruit pungency, which makes it a desirable species in many countries. Pungency of fruit depends

on the environmental factors which include soil type, osmotic properties and nutrient compositions (Soria- Fregoso *et al.*, 2002). Pepper is an important horticultural crop not only because of its economic importance but also due to the nutritional and medicinal value of its fruits as well as being an excellent source of natural colours and antioxidant compounds (Howard *et al.*, 2000). Comparatively, yield in the developing countries is about 10 – 30% higher to that obtained in developed countries (Erinle, 1989; Grubben and Tahir, 2004). The FAO world production statistics of fresh pepper regardless of type in 2013 was 31,131,226 metric tonnes, out of which Africa produced 2,873,802 metric tonnes. West Africa produced 771,424 metric tonnes, while Nigeria produced 510,000 metric tonnes. The total area put under production in the world was 1,899,956ha, Africa accounted for 352,685ha, West Africa 155,153ha, and Nigeria 65,000 ha in 2013. China is the biggest pepper producing country in the world with 15,823,000 tonnes while Nigeria top countries in West Africa. Nigeria produces about 56% of West Africa and 18.5% of Africa's production (FAO, 2013). Annual yields of hot peppers range between 15 to 55 tha^{-1} . The yields are variable and dependent on cultivar which differs in size of fruits and of plants, and on the system of cultivation (Norman, 2002). For its wide use in Nigerian diet, habanero pepper is an important traditional crop mainly valued for its pungency, aroma and color particularly by Yoruba people. The crop is one of the important spices that serve as the source of income particularly for small scale producer in any part of northern Nigeria (Howard *et al.*, 2000). Pepper has increased in popularity, value and importance over a long period, thus making it an indispensable part of the daily diet of millions of Nigerians. Pepper is normally used as a spice in the preparation of soups and stews. It can also be used as a condiment and extensively in flavoring of processed meat, coloring certain food preparation and also used for medicinal purposes (Alabi, 2006; UGCE, 2009). According to Marin *et al.* (2004), and Gil-guerrero *et al.* (2006), habanero pepper is an excellent source of natural colors and antioxidant compounds, ascorbic acid, carotenoids and phenolic compounds. It also contains vitamins A and C and it was reported that the pro-vitamin A (B Carotene) and ascorbic acid increase as hot pepper mature. The intake of these compounds in foods is an important health protecting factor, they have been recognized as being beneficial for prevention of widespread human diseases,

including cancer and cardiovascular diseases, when taken daily in adequate amounts (Kaur and Kapoor, 2001; Sardas, 2003).

MATERIALS AND METHODS

Field trial was conducted during the rainy seasons of 2016 at the experimental site of Kaduna Agricultural Development Project (KADP) located at Maigana, Soba Local Government Area and the research farm of the Institute for Agricultural Research (IAR) Ahmadu Bello University Zaria (located at Samaru in the Northern Guinea savanna ecological zone of Nigeria. The experimental site was ploughed and harrow, ridges were then made 75 cm apart with plants. Transplanted at a spacing of 20 and 40 cm within the row, seedlings were maintained for six weeks in the nursery before transplanting. The experiment consisted of 36 treatments made up of factorial combinations of three farm yard manure (FYM) rates at (0, 10, and 15 tha^{-1}), six weed control treatment which included application of Pendimethalin at 1.5 and 2.0 Kg a.i/ha each at pre-transplanting and also at post-transplanting, three hoe weeding at 3, 6 and 9 week after transplanting (WAT) and a weedy check. Two intra row spacing 20 and 40 cm. The experiment was laid in a Split Plot Design. The weed control and spacing treatments were allocated to the main plots while FYM was allocated to the sub plot. The treatments were replicated three times, the gross plot size was 4 m x 3 m (12 m^2) and the net plot was 1.5 x 4 m (6 m^2). While the inter row spacing was 75 cm. soil and manure analysis were done in accordance with Black (1965). Crop injury score, crop vigour score, number of leave, total dry matter and fresh fruit yield per hectare.were recorded on plot basis. The data collected were analysed statistically in accordance with Snedecor and Cochran (1967). Significant different means were compared using Duncan Multiple Range Test (DMRT) (Duncan, 1965).

RESULTS AND DISCUSSIONS

Table 1 shows the effect of farm yard manure, weed control methods and intra row plant spacing on crop vigour score of habanero pepper during the 2016 wet season at Samaru and Maigana. Application of farm yard manure had significant influenced on crop vigour score of habanero pepper in 2016 only at 12 WAT at Samaru and 9 WAT in Maigana. At 12 WAT at Samaru each increase

in farm yard manure rate from 0 to 10 t ha⁻¹ and further to 15 t ha⁻¹ FYM led to a corresponding increase in crop vigour score. At 9 WAT at Maigana the farm yard manure treatment with 0 t ha⁻¹ FYM had higher value for crop vigour score than for the 10 and 15 t ha⁻¹ FYM. At 6 and 9 WAT at Samaru and 6 and 12 WAT in Maigana application of farm yard manure rates had no significant difference on crop vigour score.

Weed control methods had significant influenced on crop vigour score at all the sampling periods in Samaru and Maigana. Pre transplant application of 1.5 and 2.0 kg a.i pendimethalin ha⁻¹ resulted in statistically similar and highest value for crop vigour score at 6 WAT at Samaru and Maigana, though they were statistically similar to hoe weeded control at 9 and 12 WAT at both locations. It was followed by pre transplant application of 1.5 and 2.0 kg a.i pendimethalin ha⁻¹ at 9 and 12 WAT that was statistically comparable to post transplant application of 1.5 and 2.0 kg a.i pendimethalin ha⁻¹ at 6 WAT in both locations and weedy check at 6 WAT at Samaru, then the same herbicide at post-transplant regardless of the rates at 9 and 12 WAT at both locations, though they were statistically similar to weedy check at 6 WAT in Maigana. The weedy check consistently recorded the least value for crop vigour score. The intra row spacing had no significant differences on crop vigour score throughout the sampling periods in both locations.

The interaction of all the factors on number of leaves of habanero pepper plant was not significant throughout the period of study at both locations.

Number of leaves of habanero pepper was significantly influenced by farmyard manure, weed control method and intra-row spacing at Samaru and Maigana during the 2016 wet season is shown in Table 2. Application of farmyard manure had significant effect on leaf production of pepper at all the sampling periods at both locations during the 2016 wet season. However, there was exception of 9 WAT at Samaru and 12 WAT at Maigana when the effect of farmyard manure was no significant. At 6 WAT at Samaru and 9 WAT at Maigana application of 15 t ha⁻¹ FYM produced the highest value for number of leaves that was statistically similar to that of 10 t ha⁻¹ FYM but higher number of leave than for the control. At 12 WAT at Samaru application of 10 t ha⁻¹ FYM produced higher number of leaves that was statistically the same with 0 t ha⁻¹ FYM but higher leave production than for 15 t ha⁻¹ FYM while the 15 t ha⁻¹ FYM had fewer

number of leaves that was also statistically at par with that of 0 t ha⁻¹ FYM. However, at 6 WAT at Maigana application of 15 t ha⁻¹ FYM produced the highest value for number of leaves than for 0 and 10 t ha⁻¹ FYM that are statistically similar.

The effect of weed control method on leaves production was significant at all the sampling period at both locations. Hoe weeded control consistently result in the highest number of leaves that was statistically similar to pre transplant application of 1.5 and 2.0 kg a.i pendimethalin ha⁻¹ at 9 and 12 WAT in Samaru and application of 1.5 kg a.i ha⁻¹ pendimethalin at pre transplant at 6 WAT at Samaru and Maigana though statistically at par with application of 1.5 kg a i ha⁻¹ of pendimethalin at 12 WAT at Maigana at pre transplant and post-transplant application of 2.0 kg a.i pendimethalin ha⁻¹ at 9 WAT at Maigana. it was follow by post-transplant application of 1.5 and 2.0 kg a.i of pendimethalin ha⁻¹ at 6 and 12 WAT at Samaru and 6 WAT in Maigana but statistically similar with application of 2.0 kg a i ha⁻¹ of pendimethalin at all the sampling period in Maigana and weedy check at 6 and 12 WAT in Samaru. The lowest leave production was from the weedy check at 9 and 12 WAT in Samaru and Maigana that was statistically comparable to application of 2.0 kg a.i pendimethalin ha⁻¹ at post-transplant at 9 WAT at Samaru and post-transplant application of 1.5 kg a.i pendimethalin ha⁻¹ at 9 WAT at Maigana, though statistically at par with post-transplant application of 1.5 kg a.i pendimethalin ha⁻¹ at 12 WAT at Samaru and weedy check at 9 WAT at Maigana.

The intra-row spacing had no significant effect on number of leaves in 2016 throughout the sampling periods at both locations.

The response of days to 50% flowering to farm yard manure, weed control methods and intra row spacing to habanero pepper at Samaru and Maigana during the 2016 wet season is presented in Table 3. Application of 0 t ha⁻¹ of farm yard manure significantly delayed days to 50% flowering when compared to other rates it was follow by pepper that received 10 t/ha then 15 t ha⁻¹ which resulted in earlier significantly compared to other rates in Maigana while all the applied farm yard manure rates were statistically similar in Samaru.

Hoe weeded control flowered much earlier at Samaru that was statistically similar 1.5 kg a.i applied pendimethalin ha⁻¹ at pre transplant, it was followed by pre transplant application 2.0 kg a.i of pendimethalin ha⁻¹ followed by weedy

check then post transplant application of pendimethalin at both rates which flowered late. However, hoe weeded control flowered earlier much than the other weed control method at Maigana. It was thereafter followed by pre transplant application of 1.5 kg a.i of pendimethalin ha⁻¹ then post transplant application of 1.5 kg a.i of pendimethalin ha⁻¹ the weedy check which finally flowered late.

Intra-row spacing had significant effect on days to 50% flowering only at Maigana were 40 cm intra-row spacing flowered earlier much than the 20 cm intra-row spacing, while at Samaru all the intra row spacing did not significantly affect the parameter.

The interaction between the factors on 50% flowering was not significant at both locations.

Number of fruits per plant of habanero pepper as influenced by farmyard manure, weed control method and intra-row spacing at Samaru and Maigana during the 2016 wet season is presented in Table 4. Application farmyard manure had significant influenced in number of fruits only at Samaru were application of 10 and 15 t ha⁻¹ FYM resulted in statistically similar but higher number of fruits per plant than for the control at Samaru. However, at Maigana the effect of the three farm yard manure rates on number of fruit per plant was no significant.

The weed control method had significant influenced on number of fruits per plant at all the sampling period at both locations. Application of 1.5 kg a.i of pendimethalin ha⁻¹ applied pre transplant resulted in the highest number of fruit per plant in Samaru that was statistically similar to pre transplant application of 1.5 and 2.0 kg a.i of pendimethalin ha⁻¹ in Maigana. It was followed by hoe weeded control at both locations, and then followed by post-transplant application of 1.5 kg a.i pendimethalin ha⁻¹ in Maigana though statistically similar with pre transplant application of 2.0 kg a.i pendimethalin ha⁻¹ in Samaru then post-transplant application of 2.0 kg a.i of pendimethalin ha⁻¹ in both locations. The weedy check generally resulted in the least value for number of fruits per plant in both locations.

The intra-row spacing was significant at both locations. 40 cm intra-row spacing significantly produced higher number of fruits per plant than 20 cm intra-row spacing.

Interaction on number of fruit per plant was not significant throughout the study period in both locations.

Fresh fruit yield per hectare of habanero pepper as influenced by farm yard manure, weed control method and intra row plant spacing at Samaru and Maigana during the 2016 wet season is presented in Table 5. Application of farmyard manure significantly influenced fresh fruit yield per hectare of habanero pepper in both locations. Increasing farmyard manure rate from 0 to 10 and further to 15 t ha⁻¹ FYM significantly enhanced fresh fruit yield per hectare of habanero pepper.

Weed control method recorded significant influenced on fresh fruit yield of pepper per hectare in both locations. Hoe weeded control significantly produced higher fresh fruit yield at both locations though statistically similar to pre transplant application of 1.5 kg a.i pendimethalin ha⁻¹ at Samaru. It was followed by pre transplant application of 2.0 kg a.i pendimethalin ha⁻¹ at both locations then pre transplant application of 1.5 kg a.i pendimethalin ha⁻¹ in Maigana that was statistically similar to post transplant application of 1.5 kg a.i pendimethalin ha⁻¹ at Samaru then followed by post-transplant application of 1.5 and 2.0 kg a.i pendimethalin ha⁻¹ in both locations. The least fresh fruit yield per hectare was recorded by weedy check.

Intra-row plant spacing had significant effect on fresh fruit yield per hectare of habanero pepper. Transplanting habanero pepper at 40 cm intra-row plant spacing resulted in significantly heavier fresh fruit yield per hectare of habanero pepper than 20 cm intra-row spacing at Maigana, while varying intra row spacing from 20 to 40 cm in Samaru does not have significant effect on fresh fruit yield of pepper. .

The factors interaction on fresh fruit yield per hectare was not significant throughout the study periods in both locations.

DISCUSSIONS

Habanero pepper showed either similarities or differences in growth and development. The variation in growth and development could be attributed to the adequate and well distributed rainfall experiences in 2016 which is adequate for both vegetative and reproductive phases of the crop. Also the better performance at Samaru can be due to relatively higher available nitrogen and phosphorus content of the experimental site at Samaru (2.5 and 7.07 mgkg⁻¹) and Maigana (1.81 and 5.02 mgkg⁻¹) and (3.10 and 10.98 mg kg⁻¹) and (2.50 and 8.98 mgkg⁻¹) in 2016. The greater vegetativeness of pepper in terms of height per plant, number of leaves and branches, number could be

due to larger assimilatory leaf area surface which enable it to produce assimilate and more vegetative growth. Similar differences in pepper have being reported by Delegen, (2011). This further suggest that high yield in pepper is dependent on leaf area and fruit size. The delay in flowering observed could be due to vegetativeness which might have delayed transition into the reproductive phase. The delay in flowering and the heavy demand for assimilates to support the heavy vegetation might have resulted in smaller fruit size and hence lower fruit yield. The early flowering recorded might have given it advantage for longer duration for assimilate partitioning for heavier fruits. Delelegen (2010) also reported variation in days to 50% flowering, number of fruit per plant and number of branches between different rates of manure and attributed the differences variation in genetic make-up The growth and yield component of pepper was significantly influenced when farm yard manure were added at both locations. The response exhibited by habanero pepper to farm yard manure was observed through increased weed cover score, weed dry weight, crop vigour score, plant height, number of leaf, total dry matter accumulation as well as reduction in days to 50% flowering and increase yield and yield characters at both location this could be as a result of positive increased in mineralized nutrient which improve soil physical and chemical condition and also improved availability of macro and micro nutrient in the soil that were necessary for the formation of chlorophyll, efficient rooting and production of biomass (Anon, 2007b).

Apart from increasing soil fertility, manure, serves as a soil amendment by adding organic matter content into the soil. Farm yard manure has been reported to greatly improve water holding capacity, soil aeration, soil structure, nutrient retention and microbial activity (Anon, 2007a). Manure application also results in increased pH and decreased in bulk density, when use in long term basis (Anon, 2006). It was even reported that farm yard manure contains nitrogen for photosynthetic activities, vigorous growth and dark green colour of the leaves (Kamara, *et. al.*, 2011). The application of farmyard manure of 15 t ha⁻¹ was also observed to increase the fruit size, fresh fruit weight per plant and fresh fruit yield of habanero pepper throughout the season. The increase in yield by the application of farmyard manure can be attributed to the favourable effect of the farmyard manure on growth and yield characters such as plant height, number of leaves, plant dry matter production, leaf area which all have direct bearing on the final yield of the crop. This finding is in line with the finding of Akande *et al.* (2006) who found that farm yard manure applied along with Ogun rock phosphate significantly increase yield. Also Mondal *et. al* (1992) reported that application of 10 t ha⁻¹ of

farmyard manure significantly increased the yield of sesame compared to other level of applied organic manure.

The increase in fruit weight at FYM from 0, 10 to 15 t ha⁻¹ might be attributed to solubilization of plant nutrient by addition of FYM leading to increase in uptake of plant nutrient or could be the ability of manure creating suitable plant growing environment by improving moisture and nutrient status of the soil (Subbaian *et al.*, 1982). The result is in line with finding of Eifediyi *et al.* (2010). All the weed control treatments significantly reduced weed infestation as reflected on weed cover score, weed dry weight, crop injury score and significantly increase weed control efficiency, crop vigour score, growth and yield parameters recorded with the weed control treatment compare to the weedy check throughout the periods of the study.

Pre transplant application of 1.5 and 2.0 kg a.i pendimethalin ha⁻¹ as well as hoe weeded control at 6, 9 and 12 WAT gave effective control of weeds on mostly all the growth and yield parameters and also led to early flowering in both season. Post-transplant application of 1.5 and 2.0 kg a.i pendimethalin ha⁻¹ was not effective in the control of sedge which could be as a result of tolerance or resistance of sedges to this herbicide. Sedges possess mechanism that prevent the entry or movement of herbicide or deactivates the herbicides completely in converting the toxins to harmless metabolites (Gary and Zo Shey 1974). Effective control of broad leaves, grasses and sedges was achieved with the hoe weeding compared to application of pendimethalin at all rate. This could be attributed to the fact pendimethalin at 1.5 and 2.0 kg a.i ha⁻¹ could not adequately control sedges. Rawlinson and Martin (1998) reported that in some cases low herbicides rates may result in incomplete weed control in heavy infested sites. Hoe weeded controlled all weeds (grasses, broadleaves and sedge) this is in line with the finding of Joy *et al.* (2006) who reported that weeds control treatment and hoe weeding at 20 and 40 days after sowing controlled weeds. performance when kept weed free. In both seasons, the weedy check significantly recorded the least crop vigour score, shorter plant and low number of leaves throughout the season this is due to uncheckable weed competition for resources which result in shorter plant. The crop performance on yield parameters such as number of fruit per plant, fruit size, fresh fruit weight per plant and fresh fruit yield ha⁻¹ were higher with all the weed control treatments as compared to the weedy check. Hoe weeded control as well as application of 1.5 and 2.0 kg a.i of pendimethalin ha⁻¹ at pre transplant significantly increases number of fruit per plant, fresh fruit size, fresh fruit weight per plant and fresh fruit yield per hectare at both locations and season. The production of heavier fruit, bigger and highest number of fruit with habanero pepper is with hoe weeding and pre transplant application of

1.5 and 2.0 kg a.i of pendimethalin ha⁻¹ at both locations and season. This could be attributed to effective weed control which in turn translated into availability of more nutrient and the ability of the crop to take up this nutrient for their use. This result is agree, with Kalhapure *et al.* (2013) who reported the highest yield attributes and fruit yield were observed with three hand weeding at 20, 40 and 60 DAT. The better performance of hoe weeded control and pre transplant application of 1.5 and 2.0 kg a.i ha⁻¹ of pendimethalin at earlier flowering, higher fresh fruit weight, number of fruit and fresh fruit yield tonnes per hectare can be attributed to good weed suppression effect that allowed greater efficiency in the use of available growth and yield factors. Crop perform better under good weed management practices (Adigun, 1991; Ahmed and Kanded, 1993; Gana, 1997, Shebayan (1998); Grichar *et al.* (2004); and Ishaya (2004) have reported similar findings. The results of this study show a significant response to varying intra-row plant spacing by some growth parameters as well as the yield. 40 cm intra-row spacing resulted in higher crop vigour score, taller plant, higher number of leaves and branches. This is as a result of wide spaced plant might have had more environmental resource for growth hence more leaves per plant and number of branches per plant than those closely spaced plants. Similar finding was reported by Liu *et al.* (2004) and Luque *et al.* 2006 who reported that decrease in intra-row plant spacing tend to decrease LAI per plant. The significantly and higher value for LA, LAI, TDW, NAR and RGR at 40 cm intra-row plant spacing could be because wider spaced plant might have had more environmental resources for growth as a result of less competition at this spacing, produced taller plant with sprayed canopy that could intercept more light. This in turn increased the dry matter production as observed with the 40 cm spaced plant thereby increasing the rate of the crop growth. Similar findings were earlier reported by Naeem (1998), Mohsan (1999), Inuwa (2001), Maddoni *et al.*, (2001), Ma *et al.* (2007) and Ahmad (2010) who stated that decreased in intra-row spacing decrease dry matter production. The lack of response of number of days to 50% flowering to intra-row plant spacing could mean that genes and other environmental factors, rather than space control these important parameters.

Conclusion

Application of farmyard manure at 15 t/ha, hoe weeded at 3, 6 and 9 WAT and 40 cm intra row spacing resulted in better crop growth and yield.

Table 1: Effect of farmyard manure, weed control method and intra-row spacing on crop vigour score of Habanero pepper (*Capsicum chinense* L.) at Samaru and Maigana during 2016 wet season.

Treatments	Crop Vigour Score					
	SAMARU (WAT)			MAIGANA (WAT)		
	6	9	12	6	9	12
Farm yard Manure (FYM) (t/ha)						
0	8.00	7.42	5.86c	8.56	7.81a	5.89
10	8.02	7.25	6.22b	8.47	7.56b	6.14
15	8.05	6.68	6.58a	8.50	7.56b	5.99
S.E.±	0.067	0.070	0.101	0.062	0.065	0.086
Weed control methods (WC) (kg a.i/ha)						
Pendimethalin (Pre-Tp) 1.5	9.00a	7.67b	6.78b	9.00a	8.33b	7.28b
✓ 2.0	9.00a	7.67b	6.78b	9.00a	8.56ab	7.39b
Pendimethalin (PO-Tp) 1.5	7.56b	6.39c	5.56c	8.33b	7.00c	4.78c
✓ 2.0	7.56b	6.39c	5.38c	8.33b	6.89c	5.00c
Hoe Weeding at 6, 9 and 12 WAT	7.67b	9.00a	7.94a	8.39b	8.72a	8.28a
Weedy check -	7.39b	5.94d	4.89d	8.00c	6.33d	3.28d
S.E.±	0.095	0.099	0.143	0.088	0.092	0.121
Spacing (SPC) (cm)						
20	8.06	7.12	6.29	8.56	7.69	5.93
40	8.00	7.23	6.14	8.46	7.59	6.07
S.E.±	0.055	0.057	0.083	0.050	0.053	0.070
Interactions						
FYM x WC	NS	NS	NS	NS	NS	NS
FYM x SPC	NS	NS	NS	NS	NS	NS
WC x SPC	NS	NS	NS	NS	NS	NS
FYM x WC x SPC	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within a treatment group are not significantly different at 0.05 level of probability using DMRT = Duncan Multiple Range Test. NS=Not Significant

Pre-Tp = Pre-transplanting Po-Tp = Post-Transplanting FYM = Farmyard Manure

SP = Intra-row Spacing WC = Weed control

Table 2: Effect of farmyard manure, weed control method and Intra-row spacing on number of leaves of Habanero pepper (*Capsicum chinense* L.) at Samaru and Maigana during 2016 wet season.

Treatments	Number of Leaves					
	SAMARU (WAT)			MAIGANA (WAT)		
	6	9	12	6	9	12
Farmyard Manure (FYM) (t/ha)						
0	23.97b	48.75	87.97ab	12.67b	30.06b	76.94
10	24.91a	52.31	98.03a	12.83b	31.25a	75.56
15	25.13a	51.19	85.00b	13.22a	31.61a	85.97
S.E.±	0.273	1.549a	4.354	0.080	0.395	3.666
Weed control methods (WC) (kg a.i/ha)						
Pendimethalin (Pre-Tp) 1.5	25.50a	63.72a	120.38a	13.39a	30.22bc	100.50ab
✓ 2.0	23.83b	68.00a	122.28a	12.33b	31.11b	86.11b
Pendimethalin (Po-Tp) 1.5	24.33b	53.89b	69.89b	12.28b	29.33c	57.06cd
✓ 2.0	24.11b	36.50c	53.72b	12.22b	31.44ab	55.17d
Hoe Weeding at 6, 9 and 12 WAT	26.00a	47.94b	110.89a	13.67a	32.83a	107.17a
Weedy check -	24.27b	34.44c	64.94b	13.56a	30.89bc	70.94c
SE+	0.385	2.192	6.158	0.113	0.559	5.171
Spacing (SPC) (cm)						
20	24.46	53.63	90.61	12.87	30.83	76.79
40	24.89	47.87	90.09	12.94	31.11	82.16
S.E.±	0.223	1.265	3.556	0.065	0.323	2.986
Interactions						
FYM X HBC	NS	NS	NS	NS	NS	NS
FYM X SPC	NS	NS	NS	NS	NS	NS
HBC X SPC	NS	NS	NS	NS	NS	NS
FYM x SPC x WC	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within a treatment group are not significantly different at 0.05 level of probability using DMRT = Duncan Multiple Range Test. NS=Not Significant

Pre-Tp = Pre-transplanting Po-Tp = Post-Transplanting FYM = Farmyard Manure

SP = Intra-row Spacing WC = Weed control

Table 3: Effect of farmyard manure, weed control method and intra-row spacing on days to 50% flowering of Habanero pepper (*Capsicum chinense* L.) at Samaru and Maigana during 2016 wet season.

Treatments	Days to 50% Flowering	
	SAMARU	MAIGANA
Farmyard Manure (FYM) (t/ha)		
0	65.25	66.58c
10	65.89	67.78b
15	65.22	68.42a
S.E.±	0.366	0.104
Weed control methods (WC) (kg a.i/ha)		
Pendimethalin (Pre-Tp) 1.5	61.17d	64.33e
✓ 2.0	64.00c	67.00d
Pendimethalin (PO-Tp) 1.5	69.50a	68.17c
✓ 2.0	69.72a	70.72b
Hoe weeding at 6, 9 and 12 WAT	60.94d	63.50f
Weedy check -	67.39b	71.83a
S.E.±	0.518	0.147
Intra-row Spacing (cm)		
20	65.29	67.83a
40	65.61	67.36b
S.E.±	0.299	0.085
Interactions		
FYM x WC	NS	NS
FYM x SPC	NS	NS
HBC x SPC	NS	NS
FYM x SPC x WC	NS	NS

Means followed by the same letter(s) within a treatment group are not significantly different at 0.05 level of probability using DMRT = Duncan Multiple Range Test. NS=Not Significant

Pre-Tp = Pre-transplanting Po-Tp = Post-Transplanting FYM = Farmyard Manure

SP = Intra-row Spacing WC = Weed control

Table 4: Effect of farmyard manure, weed control method and intra-row spacing on number of fruits per plant of habanero pepper (*Capsicum chinense* L.) at Samaru and Maigana during 2016 wet season.

Treatments	Number of Fruits per Plant	
	SAMARU	MAIGANA
Farmyard Manure (FYM) (t/ha)		
0	58.22b	53.42
10	61.17a	52.36
15	62.92a	55.22
S.E.±	0.949	1.094
Weed Control Methods (WC) (Kg a.i/ha)		
Pendimethalin (Pre-Tp) 1.5	77.44a	72.00a
✓ 2.0	63.31c	70.00a
Pendimethalin (PO-Tp) 1.5	50.33e	50.33c
✓ 2.0	56.83d	39.50d
Hoe weeding at 6, 9 and 12 WAT	71.22b	56.17b
Weedy check -	45.39f	34.00e
S.E.±	1.340	1.547
Intra-row Spacing (cm)		
20	58.06b	50.17b
40	63.48a	57.17a
S.E.±	0.774	0.893
Interactions		
FYM x HBC	NS	NS
FYM x SPC	NS	NS
HBC x SPC	NS	NS
FYM x HBC x SPC	NS	NS

Means followed by the same letter(s) within a treatment group are not significantly different at 0.05 level of probability using DMRT = Duncan Multiple Range Test. NS=Not Significant

Pre-Tp = Pre-transplanting Po-Tp = Post-Transplanting FYM = Farmyard Manure

SP = Intra-row Spacing WC = Weed control

Table 5: Effect of farmyard manure, weed control and intra-row spacing on Fresh Fruit Yield tons per Hectare of habanero pepper (*Capsicum chinense* L.) at Samaru and Maigana during 2016 rainy season.

Treatments	Fresh fruit yield (t/ha)	
	SAMARU	MAIGANA
Farmyard Manure (FYM) (t/ha)		
0	14.13c	11.43c
10	15.46b	11.85b
15	17.47a	12.30a
S.E.±	0.135	0.033
Weed control methods (WC) (kg a.i/ha)		
Pendimethalin (Pre-Tp) 1.5	19.24a	15.15c
✓ 2.0	17.75b	15.56b
Pendimethalin (PO-Tp) 1.5	15.14c	8.95e
✓ 2.0	13.88d	9.21d
Hoe weeding at 6, 9 and 12 WAT	18.80a	16.06a
Weedy Check -	9.35e	6.22f
S.E.±	0.190	0.047
Intra-row Spacing (cm)		
20	15.62	11.73b
40	15.76	12.00a
S.E.±	0.100	0.027
Interactions		
FYM x WC	NS	NS
FYM x SPC	NS	NS
WC x SPC	NS	NS
FYM x WC x SPC	NS	NS

Means followed by the same letter(s) within a treatment group are not significantly different at 0.05 level of probability using DMRT = Duncan Multiple Range Test. NS=Not Significant

Pre-Tp = Pre-transplanting Po-Tp = Post-Transplanting FYM = Farmyard Manure

SP = Intra-row Spacing WC = Weed control

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