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Performance of Habanero Pepper (*Capsicum Chinense* L.) Variety as Influenced by Farmyard Manure, Weed Control and Intra Row Spacing in Northern Guinea Savannah.

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

Abstract

The study show the effect of farmyard manure at 0, 10 and 15 t/ha six weed control treatments which included application of pendimethalin at 1.5 and 2.0 Kg a.i/ha each at pre-transplanting and also post-transplanting and three hoe weeding at 3, 6 and 9 week after transplanting (WAT), weedy check and two intra row spacings 20 and 40 cm on growth and yield of habanero pepper were evaluated under field condition in 2015 and 2016 at the experimental site of Kaduna Agricultural Development Project (KADP) located at Maigana, Soba Local 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. Farmyard manure application significantly increased crop injury score, crop vigour score, number of leave, total dry matter and fresh fruit yield per hectare. However, 15 t/ha of applied manure significantly produced higher growth

and yield component of pepper, hoe weeding at 3, 6 and 9 weeks after transplanting (WAT) and 1.5 and 2.0 kg a.i/ha of pendimethalin significantly produced higher crop vigour score, number of leave , total dry matter and fruit yield. However, no manure treatment, weedy check and 20 cm produced higher crop injury score. Application of 15 t/ha of farmyard manure and hoe weeding with 40 cm intra row spacing resulted in higher yield of habanero pepper.

Introduction

Habanero pepper (*Capsicum chinense* L.) in one of the most important vegetables grown in Nigeria and other sub-humid and semi-arid tropics. After tomato and onion Habanero pepper is the third most important vegetable in Nigeria. Nigeria being the largest producer of crops in Africa account for 50% of the African production (Aliyu, 2001). Nutritionally, according to (Marin *et al.* 2004, and Gil-guerrero, 2006), habanero peppers are an excellent source of natural colours and antioxidant compounds, ascorbic acid, carotenoids, and phenolic compounds. It also contains vitamins A and C and it was reported that as hot pepper matures, the pro-vitamin A (B Carotene) and ascorbic acid increase. The intake of these compounds in foods is an important health protecting factor. Mediated intake of these compounds have been recognize to prevent some human diseases, including cancer and cardiovascular diseases, (Kaur and Kapoor, 2001; Sardas, 2003). This led to extensive production of habanero pepper varieties in some countries for export markets. However, inspite of the important of pepper in Nigeria. Low yield were often obtained by farmers due to use of low yielding varieties, inadequate application of nutrients on soil that are already of low nutrients status, poor agronomic practices, improper row or planting arrangement, low soil fertility and other environmental factors such as the prevalence of fungal (blight) and bacterial as well as viral diseases (Fekudu and Dandena, 2006). The use of organic fertilizers and herbicide has attracted attention in recent years in vegetables as a result of sustainable high yield and due to the fact that inorganic fertilizers alone cannot sustain the productivity of the soil under highly intensive

cropping systems (Singh and Jain, 2004). Weed competition is one of the most important factors limiting habanero pepper yield particularly at early stages of the crops life cycle. The study is aimed at determining the effect of farmyard manure, the best weed control treatment and intra row spacing on the growth, yield and yield components of Habanero pepper.

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). Show the effect of yard manure, weed control and intra row spacing on crop injury score at samaru and maigana during the 2015 rainy season. The difference between the applied manure are significant similar at 6 WAT in

samaru and all the sampling period at maigana, while the control produced higher crop injury score compared to all the other rates. Weedy check produced the higher crop injury score at all the sampling period and location but statistically similar with 1.5 and 2.0 kg a.i/ha of applied pendimethalin at post transplanting compared to the other weed control treatment. The intra row spacing was significant at 12 WAT at samaru.

The applied manure rate from 10-15 t/ha were significantly similar at 12 WAT at samaru and 6 WAT at maigana further increased led to a significant decrease bin crop vigour score, whereas there were no significant difference between all the other rate of applied manure at 6, 9 WAT at samaru and 9, 12 WAT at maigana (Table 2). 1.5 and 2.0 kg a.i/ha o applied pendimethalin at pre transplanting at samaru and 6, 9 WAT at maigana are significantly similar with hoe weeded control at 6, 12 WAT at samaru and 9, 12 WAT at maigana but significantly produced higher crop vigour score than all the other weed control treatment. No significant difference was observed between the intra row spacing at all the sampling period at both location.

The effect of farmyard manure, weed control and intra row spacing on number of leaves was shown on (Table 3). Increased manure led to a significant increase in number of leave at 6, 9 WAT at samaru and 12 WAT at maigana whereas 0-10 t/ha are statistically similar but significantly lower than 15 t/ha at 12 WAT in samaru. Generally hoe weeded control significantly produced higher number of leaves throughout the sampling period at both location except at 6 WAT in samaru were 1.5 and 2.0 kg a.i/ha of applied pendimethalin significantly produced higher number leave but is at par with that of 9 WAT at maigana. Number of leave was significant at 6, 12 WAT at samaru and 12 WAT at maigana with each increase in intra row spacing.

The total dry matter accumulation was significant with each increase in applied manure at 9, 12 WAT at samaru and all the sampling period at maigana (Table). Hoe weeded control significantly produced higher dry matter at all the sampling period at both location but was significantly similar with 1.5 and 2.0 kg a.i/ha of applied pendimethalin at pre transplanting, post transplanting and weedy check at 6 WAT in samaru, but significantly higher than all the other weed control treatment at both location. Increased in intra row spacing led to a corresponding increase in dry matter accumulation except at 6 WAT at samaru were increased in spacing was statistically similar.

The yield of habanero pepper was highly significant with each increased in manure rate from 0-10 and further to 15 t/ha at both location. Hoe weeded control significantly produced higher yield compared to all the other weed control treatment and weedy check at samaru and maigana. Intra row spacing was significantly with each increase in spacing at both location.

DISCUSSIONS

The positive response of growth and yield components such as number of leaves, total dry matter and fresh fruit yield per hectare to application of farmyard manure rate in both locations could be attributed to the role manure plays in supplying many of the plant nutrients, increased water holding capacity and soil structure. The increase in the number of leaves, plant height, leaf area and number of branches as a result of manure application could be attributed to role it plays in improving soil conditions (moisture retention, soil structure and aeration and increase nitrogen availability). Nitrogen which is one of major component of manure is known to enhance physiological activities in crops thereby improving the synthesis of photo-assimilates (Aliyu, 2000). All the weed control treatments significantly reduced weed infestation as reflected on growth and yield parameters measured with the weed control treatment compare to the weedy check throughout the period of the trials. The weedy check treatment had significantly higher weed cover score and weed dry weight than hoe weeded control and all the pre and post emergence herbicide treatments at all the sampling period in both locations in the two years of study. All the herbicide treatments at the higher rates and the three hoe weeding significantly reduced weed cover score and weed dry weight at both locations. This observation can be attributed to the fact that the herbicide effect increase with increase in dose and resulted not only in drastic reduction of weed cover, but also reduced dry matter accumulation of pepper through photosynthesis inhibition. Several researchers have reported reduction in weed dry matter production due to herbicide application in various crops (Tunku, 1997; and Ishaya, 2004). In 2015 at samaru at 6 WAT and 6 and 9 WAT 1.5 and 2.0 Kg a.i/ha of pendimethalin at pre-emergence are statistically similar but significantly higher than all the other weed control method and weedy check, this is as a result of effective weed control which had reduced the level of competition for growth resources in pepper there by making them available

to plant and consequently result in taller and higher number of leaves. 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 production of shorter plant by weedy check was expected because weed competition in plant for growth resources usually retards growth.

The result of this study show a significant response to varying intra row 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 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 spacing tend to decrease LAI per plant. The yield and yield component studied also responded significantly to variation in intra row spacing. Number of fruit per plant, fruit size per plant, fresh fruit weight per plant were all increased significantly with increase in intra row spacing from 20 to 40 cm. The increase in yield component might be due to better light interception by 40 cm spaced plant, hence higher dry matter for fruit. The higher fruit yield obtained at 40 cm intra row spacing could be attributed to higher number of plant and harvestable fruit at 40 cm spacing.

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 farm yard manure, weed control and intra row spacing on crop injury score of Habanero pepper (*Capsicum chinense* L.) at Samaru and Maigana during 2015 rainy season.

	CROP INJURY SCORE					
	SAMARU (WAT)			MAIGANA (WAT)		
TREATMENTS	6	9	12	6	9	12
FARM YARD MANURE (FYM) (T/HA)						
0	1.53a	2.31a	3.56a	1.64a	2.83a	4.66a
10	1.36a	2.14ab	3.25b	1.86a	2.86a	4.69a

15	1.33a	2.06b	3.14b	2.00a	2.92a	4.44a
S.E.±	0.069	0.079	0.075	0.067	0.092	0.085
WEED CONTROL METHODS (WC) (KG A.I/HA)						
PENDIMETHALIN (PRE-EM) 1.5	1.00c	1.06c	1.50c	1.06e	1.67c	2.94c
PENDIMETHALIN (PRE-EM) 2.0	1.00c	1.06c	1.56c	1.00e	1.50cd	3.00c
PENDIMETHALIN (POE) 1.5	1.56ab	3.00b	4.27b	2.11c	4.11b	6.11b
PENDIMETHALIN (POE) 2.0	1.67ab	3.17b	4.51b	2.39b	4.00b	6.17b
HOE WEEDING AT 6, 9 AND 12 WAT	1.38b	1.06c	1.67c	1.78d	1.28d	2.17d
WEEDY CHECK	1.83a	3.67a	6.39a	2.67a	4.67a	7.22a
S.E.±	0.097	0.111	0.107	0.095	0.131	0.121
SPACING (SPC) (CM)						
20	1.39a	2.15a	3.22b	1.80a	2.85a	4.45a
40	1.43a	2.19a	3.41a	1.87a	2.89a	4.67a
S.E.±	0.056	0.064	0.061	0.054	0.075	0.069
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 0.05level of probability using DMRT NS=Not Significant.

Table 2: Effect of farm yard manure, weed control and intra row spacing on crop vigour score of Habanero pepper (*Capsicum chinense* L.) at Samaru and Maigana during 2015 rainy season.

	CROP VIGOUR SCORE					
	SAMARU (WAT)			**MAIGANA (WAT)**		
TREATMENTS	6	9	12	6	9	12
FARM YARD MANURE (FYM) (T/HA)						
0	8.44a	7.28a	6.78b	8.00b	7.08a	5.56a
10	8.42a	7.28a	6.97a	8.14ab	7.11a	5.30a
15	8.14b	7.17a	6.94a	8.33a	7.17a	5.33a
S.E.±	0.081	0.090	0.074	0.072	0.095	0.086

WEED CONTROL METHODS (WC) (KG A.I/HA)						
PENDIMETHALIN (PRE-EM) 1.5	8.78a	8.44a	7.83a	8.94a	9.33a	7.06b
PENDIMETHALIN (PRE-EM) 2.0	8.94a	8.56a	8.00a	9.00a	8.50a	7.00b
PENDIMETHALIN (POE) 1.5	7.94b	6.39c	6.22b	7.89bc	5.89b	3.89c
PENDIMETHALIN (POE) 2.0	7.83b	6.33c	6.11b	7.61cd	6.00b	3.83c
HOE WEEDING AT 6, 9 AND 12 WAT	8.67a	8.00b	7.94a	8.17b	8.72a	7.83a
WEEDY CHECK	7.83b	5.72d	5.17c	7.33d	5.28c	2.78d
S.E.±	0.114	0.127	0.105	0.103	0.135	0.121
SPACING (SPC) (CM)						
20	8.33a	7.29a	6.85a	8.18a	7.13a	5.46a
40	8.33a	7.19a	6.91a	8.13a	7.11a	5.33a
S.E.±	0.066	0.073	0.061	0.059	0.077	0.069
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 0.05level of probability using DMRT NS=Not Significant

Table 3: Effect of farm yard manure, weed control and intra row spacing on number of leaves of Habanero pepper (*Capsicum chinense* L.) at Samaru and Maigana during 2015 rainy season.

	NUMBER OF LEAVES PER PLANT					
	SAMARU (WAT)			**MAIGANA (WAT)**		
TREATMENTS	6	9	12	6	9	12
FARM YARD MANURE (FYM) (T/HA)						
0	10.00c	33.53c	81.19b	8.19a	26.83a	68.28c
10	10.94b	34.03b	83.60b	7.97a	27.94a	72.28b
15	11.69a	34.61a	90.78a	8.17a	28.14a	76.14a
S.E.±	0.131	0.095	1.106	0.111	0.964	0.993
WEED CONTROL METHODS (WC) (KG A.I/HA)						
PENDIMETHALIN (PRE-EM) 1.5	13.17a	38.89c	96.61b	8.11b	29.50ab	82.28b

PENDIMETHALIN (PRE-EM) 2.0	13.22a	39.44b	99.72b	8.22b	29.94ab	82.89b
PENDIMETHALIN (POE) 1.5	9.61c	28.61d	66.33c	7.56c	26.50bc	53.11c
PENDIMETHALIN (POE) 2.0	9.60c	28.33d	68.55c	7.83bc	24.28c	53.89c
HOE WEEDING AT 6, 9 AND 12 WAT	10.44b	42.33a	125.94a	8.83a	31.17a	106.83a
WEEDY CHECK	9.00d	27.17d	54.06d	8.11b	24.44c	54.38c
S.E.±	0.185	0.134	1.565	1.157	1.363	1.404
SPACING (SPC) (CM)						
20	10.63b	34.07a	83.52b	8.04a	27,85a	70.43b
40	11.09a	34.04a	86.87a	8.19a	27.43a	74.04a
S.E.±	0.107	0.770	0.903	0.090	0.786	0.810
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 0.05level of probability using DMRT NS=Not Significant

Table 4: Effect of farm yard manure, weed control and intra row spacing and on total dry weight of Habanero pepper (*Capsicum chinense* L.) at Samaru and Maigana during 2015 rainy season.

TOTAL DRY WEIGHT (G)

	SAMARU (WAT)			**MAIGANA (WAT)**		
TREATMENTS	6	9	12	6	9	12
FARM YARD MANURE (FYM) (T/HA)						
0	17.82a	47.86c	90.30c	20.77c	54.66c	70.51c
10	15.38a	64.79b	103.34b	21.66b	59.93b	77.18b
15	16.98a	68.09a	126.83a	22.83a	64.82a	83.88a
S.E.±	1.768	0.439	1.141	0.104	0.219	0.263
WEED CONTROL METHODS (WC) (KG A.I/HA)						
PENDIMETHALIN (PRE-EM) 1.5	21.68a	65.65b	125.80b	21.97b	63.43b	82.96b
PENDIMETHALIN (PRE-EM) 2.0	16.28a	65.74b	124.37b	22.17b	64.14b	83.57b
PENDIMETHALIN (POE) 1.5	16.62a	52.82c	80.92c	20.43d	54.00c	69.69d

PENDIMETHALIN (POE) 2.0	14.18a	53.91c	82.91c	20.97c	54.26c	71.30c
HOE WEEDING AT 6, 9 AND 12 WAT	17.64a	73.47a	145.81a	25.16a	74.69a	94.68a
WEEDY CHECK	13.93a	49.91d	81.13c	19.80e	48.28d	60.69e
S.E.±	2.500	0.621	1.613	0.146	0.310	0.372
INTRA ROW SPACING (CM)						
20	15.39a	59.52b	104.18b	21.60b	58.85b	75.36b
40	18.06a	60.97a	109.46a	21.91a	60.76a	79.02a
S.E.±	1.443	0.359	0.931	0.084	0.178	0.214
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 0.05level of probability using DMRT NS=Not Significant

Table 5: Effect of farm yard manure, weed control and intra row spacing on Fresh fruit yield per Hectare habanero pepper (*Capsicum chinense* L.) at Samaru and Maigana during 2015 rainy season.

FRESH FRUIT YIELD PER HECTARE

	SAMARU	**MAIGANA**
TREATMENTS		
FARM YARD MANURE (FYM) (T/HA)		
0	928.40c	792.19c
10	940.58b	848.75b
15	962.78a	876.08a
S.E.±	3.149	1.922
WEED CONTROL METHODS (WC) (KG A.I/HA)		
PENDIMETHALIN (PRE-EM) 1.5	1133.66c	1035.19c
PENDIMETHALIN (PRE-EM) 2.0	1155.88b	1044.56
PENDIMETHALIN (POE) 1.5	807.13e	779.69e
PENDIMETHALIN (POE) 2.0	822.13d	793.13d
HOE WEEDING AT 6, 9 AND 12 WAT	1416.71a	1112.13a

WEEDY CHECK	328.09f	258.76f
S.E.±	4.454	2.718
INTRA ROW SPACING (CM)		
20	932.40b	825.44b
40	955.54a	853.05a
S.E.±	2.571	1.569
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 0.05level of probability using DMRT NS=Not Significant

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