Original Research Article

Comparative Effects of Two Manure Types and Their Combinations on Growth and Yield of Watermelon (*Citrullus lanatus* (Thunb) Matsum and Nakai) in Nsukka, Southeast Nigeria

ABSTRACT

Watermelon (*Citrullus lanatus* (Thunb) Matsum and Nakai) is a high value fruit vegetable that has gained significant importance in Nigeria following the high level of satisfaction derived from its consumption, and the growing awareness of its nutritional and health benefits. However, its production has been limited to northern Nigeria with resultant increase in price of the crop. This study therefore assessed the growth and fruit yield of watermelon as influenced by pig and poultry manure rates during the 2020 late planting season (September to December). The experiment was a 3 × 3 factorial in randomized complete block design (RCBD) with three replications. Three levels of pig (P_g) and poultry (P_t) manures at 0, 5, and 10 t/ha constitutes the factors A and B, respectively. Data were collected on growth and yield attributes, and were subjected to analysis of variance (ANOVA) at $p \leq 0.05$, and principal component analysis (PCA) using GenStat discovery 10.3 edition. Correlation analysis was done using IBM SPSS (version 23). The results showed significant difference ($p<0.05$) for sole application of varying levels of pig and poultry manures as well as their combinations. For sole application of pig manure, P_g5 gave higher fruit yield (129.2 t/ha) compared to P_g10, and P_g0 (86.8 and 43.8 t/ha, respectively) while P_t10 (109.1 t/ha) outperformed P_t5 and P_t0 (92.1 and 58.5 t/ha, respectively) for sole application of poultry manure. Combination of P_g5 + P_t10 gave the best result for fruit yield (174.4 t/ha) and is thus recommended for watermelon production in Nsukka.

KEYWORDS: Growing watermelon in Nsukka, manure-combined, poultry-manure, pig-manure rate, animal manure

INTRODUCTION

Watermelon (*Citrullus lanatus* (Thunb) Matsum and Nakai) is a flowering plant species of the *Cucurbitaceae* family. In recent times, watermelon has become a widely consumed fruit in Nigeria following the high level of satisfaction derived from its consumption, and the growing awareness of its nutritional and health benefits. It is found in the local cuisines of tribes in both Northern and Southern parts of the country. Nigeria is the fourth leading producer of watermelon in Africa after Algeria, Egypt, and Sudan (FAOSTAT, 2018). Watermelons are excellent reservoirs of pro-vitamin A (Guner and Wehner, 2004), minerals, fibre and vitamins (Oyenuga and Fetuga, 1975). It is anti-carcinogenic due to the presence of lycopene in its red flesh (Wehner, 2008). Watermelons can also be used in making jams and jelly, as well as flavoring for drinks and smoothies.

The demand for watermelon in Nigeria has increased in recent years, hence leading to high cost. In addition to the laws of demand and supply, the sporadic herdsmen attacks on Northern farmers have significantly disrupted production of farmer produces including watermelon (ICG, 2018). This new trend having disrupted socio-economic life of Nigerian citizens, is very demanding for farmers, who are keen on maximizing yield and retaining quality of produce amidst fear for their lives (Kasarachi, 2016). One of the major challenges facing watermelon farming in Southeast Nigeria is the soil composition and topography. Soils of Southeastern Nigeria are low in fertility and soils used for growing watermelon should be rich in organic matter (Lawal, 2000). Watermelon grows best in soils with at least 3% organic matter (Akinrinde and Obigbesan, 2000). Local farmers have reported regular failures and successes under different types of manure in their bid to improve farming in Nsukka, Southeast Nigeria. Nitrogen fertilizer, when applied at different rates has been reported to positively affect the vegetative growth but limits flowering in cucumber (Waseem *et al*., 2008). Poultry and pig manures are two very rich sources of organic fertilizers that could significantly improve growth and yield indices of crops by positively enhancing the physicochemical properties of soil. Animal residues (biomasses) contain high amounts of carbon (Baharuddin et al., 2011), which could be used not only as fertilizer but also as a reductant in pyrometallurgical and hydrometallurgical recovery processes. The use of such residues is of increasing importance in the areas of dissolution of manganese from manganese-containing minerals or reduction of iron contents in iron-containing minerals to magnetite (Hsu et al., 2001; Rath et al., 2016).

The effects of organic manure sources on growth of watermelon are abundant in literature; however, there is paucity of information on the effect of poultry and pig manure rates on watermelon production in Nsukka, Southeast Nigeria. Increase in growth attributes of watermelon with corresponding increase in various sources of organic manure rates have been reported (Dauda *et al*., 2009; Audi *et al.*, 2013; Eifediyi *et al*., 2017). The understanding and development of an effective and economic fertilizer rate and management protocol is a prerequisite to increased crop productivity. Hence, this research was designed to tackle and establish best manure rates for good growth, yield and quality of watermelon in Southeast Nigeria.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Teaching and Research Field of the Department of Crop Science, University of Nigeria, Nsukka between 14th September to 14th December, 2020. The University is situated in the derived savanna agro ecological zone of Nigeria, at latitude of 06°52^{1}N, longitude 07°24^{1}E and 447 altitudes.

Field preparation, Treatments and Experimental Design

The field was ploughed, harrowed and partitioned into blocks. Each block was sub-divided into plots on which seedbeds were made, with each plot measuring 4.5 x 4.0 m. The experiment was a 3 x 3 factorial in randomized complete block design (RCBD), with 3 levels of poultry manure, P_t0, P_t5 and P_t10 (t/ha) as factor A and 3 levels of pig manure, P_g0, $P_g5.0$ and P_g10 (t/ha) as factor B, giving a total of 9 treatment combinations replicated 3 times. The plants were spaced 1.5 x 1 m apart with a 2 m gap between plots and blocks. Manure was applied 2 weeks before planting so as to give sufficient time for decomposition by microorganisms and subsequent release of locked-up nutrients to the plants. Buterforce (Butachlor 50% EC), a pre-emergence herbicide was sprayed on the field prior to sowing at the rate of 4 l ha^{-1}, to keep the field weed-free during the early seedling stage of the plant. Two seeds were sown per hole, which was later thinned to one at 2 weeks after planting (WAP). Laraforce Gold (Lamda-Cyhalothrin 5% + Imidacloprid 15% SC) was applied 1 week after emergence at the rate of 3 l ha^{-1} to control insect pests from feeding on the coltyledons. This process was repeated for 2 weeks at 3-days interval. Fungiforce (Chlorantraniliprole 100g + Lamda-Cyhalothrin) was sprayed at weekly interval to control early fungal infection. Manual weeding was done once at 4 WAP. Supplemental irrigation was done twice weekly to aid nutrient uptake and to cushion the effect of disrupted rainfall pattern due to climate change.

Soil Chemical and Manure Analysis

Chemical analysis of air-dry soil sample and manure were carried out at the soil chemistry laboratory of the Department of Soil Science, University of Nigeria, Nsukka. Soil pH was determined following Black (1973), exchangeable K (Meloche, 1956), organic carbon (Walkey and Black, 1934) and thereafter multiplied by 1.724 to obtain soil organic matter, available P (Bray and Kurtz, 1945) and Total Nitrogen by macro Kjeldahl method (Kirk, 1950). Chemical analysis of the manures were determined following the procedures used by Ihejiofor *et al.* (2020)

Data Collection

Data was collected on days to 50% emergence; number of leaves, vine length, number of internodes, number of secondary vines and leaf area at 4 and 6 WAP. Plant height before creeping, days to flowering, number of fruits per plant, fruit weight per plant (kg), average fruit weight (kg) and fruit yield per hectare (tonnes) were also were also reported.

Statistical Analysis

All data were subjected to a 2-way analysis of variance suitable for a factorial in randomized complete block design using GenStat Release 10.3 DE (2011). Significant treatment means were separated using Fisher's least significant difference (F_LSD) at $p<0.05$. Principal component analysis (PCA) was done using GenStat Release to determine the most varied traits in watermelon. Correlation analysis was carried out using IBM SPSS (version 23) to identify traits that had significant positive association with yield.

RESULTS AND DISCUSSION

Chemical properties of organic manure and pre-sowing soil sample

Chemical analysis of pre-sowing soil sample and organic manure showed that the soil pH was moderately acidic and Total N, P, available K and % organic matter were considerably low (Table 1) implying low inherent fertility. However**,** the pig and poultry manure contain considerably high amounts of N, P, K and organic matter and can help improve the fertility status of the soil, which in turn can translate to increased productivity for farmers. In addition, the pH of the pig and poultry manure were slightly alkaline suggesting the possibility of an upward shift in the soil pH towards neutrality when added to the soil. Pig manure had higher N and K values (3180 and 290 mg kg^{-1}), which are the two most critical elements in watermelon production compared to poultry manure (2150 and 265), respectively.

Table 1: Chemical Properties of Organic Manure and Pre-Sowing Soil Sample

Properties	Soil	Organic Manure	
		Pig	Poultry
pH(H_2O)	4.7	7.3	8.3
Total N (mg kg^{-1})	5.28	3180	2150
Total P (mg kg^{-1})	7.82	450	585
Available K (mg kg^{-1})	6.21	290	265

Organic Matter (%)	1.11	55.8	52.5

Main Effects of Pig and Poultry Manure Rates on Growth Parameters of Watermelon

Watermelon responded differently to varying levels of pig and poultry manure across the growth parameters considered. The main effect of pig manure rates had significant ($p<0.05$) influence on number of internodes, number of leaves and plant height but not on days to 50 percent emergence, leaf area, number of secondary vines and vine length. Application of P_g10 consistently gave significantly ($p<0.05$) higher number of internodes, number of leaves and plant height than the control treatment (P_g0) even though it was statistically comparable ($p>0.05$) to application of P_g5 for number of internodes at 4 WAP, number of leaves at 6 WAP and plant height (Table 2). The main effect of poultry manure rates was significant ($p<0.05$). Application of P_t10 showed superiority as it significantly ($p<0.05$) enhanced leaf area, number of internodes, number of leaves, number of secondary vines, vine length and plant height at 4 and 6 WAP compared to P_t5 and P_t0 (Table 2). The consistently higher performance recorded in application of 10 t/ha for both pig and poultry manure could be implicated on the ability and adequacy of the added manure to correct inherent imbalance of essential nutrient elements through timely release of labile organic components which provides energy and nutrients for enhanced microbial activities and nutrients uptake by plants. This report is in agreement with the findings of Dauda *et al*. (2009), Eifediyi *et al.* (2017) and Ihejiofor *et al.* (2020) who reported significant increase in crop growth parameters with supplemental organic manure addition.

Table 2: Main Effects of Pig and Poultry Manure Rates on Growth Parameters of Watermelon

Manure Rates (t/ha)	Days to 50% Emergence	Leaf Area (cm^2)		Number of Internodes		Number of Leaves		Number of Secondary Vines		Vine Length (cm)		Plant Height (cm)
		Weeks after Planting (WAP)										
		4	6	4	6	4	6	4	6	4	6	
P_g0	6.3	18.8	31.7	2.6	36.8	5.5	40.2	1.8	4.1	15.0	110.0	11.02
P_g5	6.9	21.3	26.8	3.6	38.5	5.7	43.3	2.0	4.9	19.0	116.0	13.01
P_g10	6.3	23.9	27.4	3.7	51.0	6.6	53.2	1.7	6.1	19.0	136.0	13.45
Mean	6.5	21.3	28.6	3.3	42.1	5.9	45.6	1.8	5.0	17.7	120.7	12.50
$LSD_{(0.05)}$	NS	NS	NS	0.87	10.73	0.64	10.95	NS	NS	NS	NS	1.573
P_t0	6.3	19.0	24.2	2.0	36.2	5.5	40.3	1.7	4.0	13.0	103.0	11.67
P_t5	6.8	19.1	26.5	3.6	35.9	5.6	39.4	1.7	4.5	15.0	108.0	11.85
P_t10	6.4	25.8	35.3	4.2	54.1	6.6	57.0	2.2	6.6	25.0	150.0	13.96
	6.5	21.3	28.7	3.3	42.1	5.9	45.6	1.9	5.0	17.7	120.3	12.50
$LSD_{(0.05)}$	NS	4.67	NS	0.87	10.73	0.64	10.95	NS	1.79	4.0	29.0	1.57

P_g = pig manure; P_t = poultry manure; NS=non-significant

Combined Effects of Pig and Poultry Manure Rates on Growth Parameters of Watermelon

The Combined effects of different rates of pig and poultry manure on the growth attributes of watermelon are shown in Table 3. Watermelon responded differently ($p<0.05$) to varying combinations of pig and poultry manure rates for number of internodes at 6 WAP, number of leaves at 4 and 6 WAP, vine length at 4 WAP and plant height. However, its response for days to 50 percent emergence, leaf area and number of secondary vines was similar ($p>0.05$). Combined of P_g10 + P_t10 was superior and consistently gave significantly higher number of internodes, number of leaves, vine length and plant height, relative to the other combinations while the control (P_g0 + P_t0) gave the least performance across all the traits measured. The significantly higher performance of P_g10 + P_t10 across most growth traits measured could be attributed to its higher individual nutrient composition in addition to the synergistic effect of the two interacting components.

Table 3: Combined Effects of Pig and Poultry Manure Rates on Growth Parameters of Watermelon

Treatment combinations		Days to 50% Emergence	Leaf Area (cm^2)		Number of Internodes		Number of Leaves		Number of Secondary Vines		Vine Length (cm)		Plant Height (cm)
Manure Rates (t/ha)			Weeks after Planting (WAP)										
Pig	Poultry		4	6	4	6	4	6	4	6	4	6	4
P_g0	P_t0	6.5	15.0	20.6	1.8	21.4	5.1	25.4	1.7	2.1	10.1	76	8.51
	P_t5	7.0	17.8	25.2	2.8	38.2	5.7	42.1	1.7	3.6	16.2	106	11.67
	P_t10	5.3	23.5	49.4	3.0	50.7	5.7	53.2	2.0	6.6	19.1	147	12.89
P_g5	P_t0	6.2	18.4	26.1	2.1	33.6	5.4	41.3	2.0	4.2	14.3	95	12.03
	P_t5	7.0	18.5	26.9	4.3	37.8	5.6	41.2	2.0	4.8	17.4	115	13.04
	P_t10	7.3	26.9	27.5	4.4	44.1	6.0	47.3	2.0	5.7	28.2	138	13.94
P_g10	P_t0	6.0	23.7	25.9	2.0	53.8	5.9	54.3	1.3	5.7	16.4	139	14.47
	P_t5	6.3	21.1	27.4	3.8	31.7	5.6	34.9	1.3	5.0	12.7	104	10.84
	P_t10	6.7	27.0	29.0	5.2	67.6	8.3	70.5	2.6	7.5	27.1	166	15.04
$LSD_{(0.05)}$		NS	NS	NS	NS	18.59	1.10	18.96	NS	NS	7.0	NS	NS

P_g = pig manure; P_t = poultry manure; NS=non-significant

Main Effects of Pig and Poultry Manure Rates on Yield and Yield Attributes of Watermelon

The main effect of pig manure rates on yield and yield attributes of watermelon was significant ($p<0.05$) for number of fruits per plant, fruit length, average fruit weight, fruit weight per plant and yield but not significant for number of days to flowering, and fruit diameter (Table 4). Significantly higher ($p<0.05$) number of fruits per plant, fruit length, average fruit weight, fruit weight per plant and yield (t/ha) was recorded with application of P_g5 relative to P_g10 and control (P_g0), although its effect was statistically similar ($p>0.05$) to P_g10 for fruit length and average fruit weight. The main effect of poultry manure rates on yield attributes of watermelon showed significant ($p<0.05$) for fruit length, average fruit weight, fruit weight per plant and yield per hectare but non-significant difference for number of days to flowering, number of fruits per plant and fruit diameter. Contrary to the observation in pig manure where 5 t/ha (P_g5) gave significantly higher yield index, poultry manure at P_t10 gave significantly higher fruit length, average fruit weight, fruit weight per plant and fruit yield per hectare compared to P_t5 and P_t0 (control). The significant increase in fruit parameters observed in manure treated plots relative to untreated plots could be attributed to the increase in the organic matter content of the soil following supplemental manure additions, which invariably reconditioned the soil by improving both physical and chemical properties of the soil in addition to raising the K and N levels in the soil, the two most critical elements for watermelon production. Akinrinde and Obigbesan (2000) had earlier reported that 3% organic matter content is best for watermelon production in Ibadan, Southwest Nigeria. The significant increase in yield traits with application of P_g5 over its higher level P_g10 could be attributed to excess of some nutrient elements especially nitrogen (N) which may have caused the plant to use more of its assimilate for vegetative growth (Table 3). Significantly higher yield traits observed with poultry manure at P_t10 could be implicated on its improved elemental composition in contrast to its lower levels (P_t5 and P_t0); and its improved effect on soil physicochemical properties and microbial activities (Ahamefule *et al*., 2015; Eifediyi *et al*., 2017).

Table 4: Main Effects of Pig and Poultry Manure Rates on Yield and Yield Attributes of Watermelon

Manure Rates (t/ha)	Number of Days to Flowering	Number of Fruits/ Plant	Fruit Diameter (cm)	Fruit Length (cm)	Average Fruit Weight (kg)	Fruit Weight/ plant (kg)	Yield (t/ha)
P_g0	43.6	2.6	50.4	27.1	2.5	6.6	43.8
P_g5	43.3	5.0	61.1	33.1	4.2	19.4	129.2
P_g10	43.0	3.6	55.7	34.1	4.0	13.0	86.8
Mean	43.3	3.7	55.7	31.4	3.6	13.0	86.6
$LSD_{(0.05)}$	NS	0.6	NS	4.98	0.94	3.47	23.1
P_t0	43.4	4.0	52.0	25.4	2.3	8.8	58.5
P_t5	43.7	3.7	51.0	31.4	3.5	13.8	92.1
P_t10	42.8	3.5	64.1	37.5	5.0	16.4	109.1
Mean	43.3	3.7	55.7	31.4	3.6	13.0	86.6
$LSD_{(0.05)}$	NS	NS	NS	4.98	0.94	3.47	23.1

P_g = pig manure; P_t = poultry manure; NS=non-significant

Combined Effects of Pig and Poultry Manure Rates on Yield Attributes of Watermelon

The effect of varying combinations of pig and poultry manure was significant ($P<0.05$) for some yield parameters including number of fruits per plant, fruit weight per plant, average fruit weight and fruit yield per hectare, but was not significant ($p>0.05$) for number of days to flowering, fruit diameter and fruit length (Table 5). Number of days to flowering ranged from 42 to 45 days with a mean of 43 days; fruit diameter ranged from 38.9 to 78.3 with mean 55.7 cm and fruit length ranged from 20.7 to 42.7 with mean of 31.5 cm. Fruit weight ranged 22.2 to 174.4 t/ha, which is lower than what was reported by Dauda *et al.* (2009) and Eifediyi *et al.* (2017). This could be as a result of increased photorespiration during the period of the study. The highest significant fruit weight per plant (26.2), average fruit weight (6.5) and yield per hectare (174.4) was recorded by combination of P_g5 + P_t10 whereas; control (P_g0 + P_t0) was the least (22.2). This could be implicated on their combined individual performance as observed in the main effects and as corroborated by Gondek and Mierzwa-Hersztek (2016) who reported significant increase in Cu and Zn content in sandy soils treated with pig and poultry manure amendments.

Table 5: Combined Effects of Pig and Poultry Manure Rates on Yield Attributes of Watermelon

Manure Rates (t/ha)		Number of Days to Flowering	Number of Fruits/ Plant	Fruit Diameter (cm)	Fruit Length (cm)	Fruit Weight / Plant (kg)	Average Fruit weight (kg)	Yield (t/ha)
Pig	Poultry							
P_g0	P_t0	43.7	2.7	55.9	20.7	3.3	1.2	22.2
	P_t5	44.7	2.4	38.9	27.7	5.9	2.1	39.4
	P_t10	42.3	2.7	56.3	33.0	10.5	4.2	69.8
P_g5	P_t0	43.6	6.0	51.3	27.5	16.9	2.8	112.4
	P_t5	43.3	4.7	53.8	29.0	15.1	3.2	100.7
	P_t10	43.0	4.3	78.3	42.7	26.2	6.5	174.4
P_g10	P_t0	43.0	3.3	48.9	28.2	9.2	2.8	41

P_t5	43.0	4.0	60.3	37.5	20.4	5.2	136.2
P_t10	43.0	3.5	57.8	36.8	12.5	4.1	83.1
$LSD_{(0.05)}$	NS	0.70	NS	NS	6.00	1.63	40.01

P_g = pig manure; P_t = poultry manure; NS=non-significant

Principal Component Analysis of Growth and Yield Traits

Principal component analysis (PCA) showed that ten of the twelve traits measured accounted for 83.1 percent of the total variation observed in the variety (Table 6). Internode length, fruit diameter, fruit length, vine length and number of days to flowering were the most discriminatory traits in PCA 1 accounting for 43.1 percent of the total variation. In PCA 2, number of secondary vines, number of leaves and number of internodes had the highest loadings culminating to about 27.3 percent of the total variation while days to 50 percent emergence and fruit weight were the most distinct in PCA 3, influencing about 12.6 percent of the observed variation. Hence, these ten traits are very important when selecting among varieties of the Citrullus species.

Table 6: Principal Component Analysis of Growth and Yield Traits

Traits	1	2	3
Days to 50% emergence	0.10	-0.02	-0.69
Days to flowering	-0.36	0.24	0.07
Fruit diameter	-0.37	0.14	-0.23
Fruit length	-0.36	-0.08	-0.31
Fruit weight	-0.29	-0.13	-0.40
Internode length	0.38	-0.13	-0.14
Leaf area	-0.25	-0.15	0.39
Number of fruits	-0.07	0.21	0.01
Number of leaves	-0.16	-0.45	0.12
Number of secondary vines	0.13	-0.50	-0.05
Number of internodes	-0.20	-0.43	0.10
Plant height before creeping	-0.28	-0.35	-0.04
Vine length	0.36	-0.25	-0.10
Latent roots	5.60	3.55	1.64
Percentage variation	43.10	27.33	12.62

Correlation Coefficients among Growth and Yield Attributes of Watermelon

Correlation analysis (Table 7) showed significant strong positive ($n=9$, $p<0.05$, $r\geq0.7$) and strong negative ($n=9$, $p<0.05$, $r\geq-0.7$) associations amongst growth and yield attributes of watermelon. Plant height was positively correlated with number of leaves, leaf area and number of internodes. Vine length had positive association with internode length, and negative association with days to flowering and fruit diameter. Internode length had negative relationship with days to flowering and number of secondary vines. Number of leaves was positively correlated with number of internodes; fruit diameter had positive association with fruit length, leaf area and days to flowering but negative association with internode length and vine length. Fruit weight had positive correlation with fruit length and leaf area. The significant strong positive correlation observed between fruit weight and leaf area could be implicated on the increased ability of broader leaves to intercept solar radiation resulting (increased photosynthetic activities) relative to narrow leaves. This report is in agreement with Dauda *et al*. (2009) who implicated increased number of fruits and average fruit weight on increased meristematic, physiologic and photosynthetic activities following supplemental addition of poultry manure; and Audi *et al*. (2013) who suggested increased interception of solar radiation as a function of increased number of leaves.

Table 7: Correlation Coefficients among Growth and Yield Attributes of Watermelon

	D50E	NOL	PLTH	NOI	IL	DTF	NSV	LA	VL	NOF	FWtP	FDP	FLP
D50E	1	.166	-.024	.661	.321	-.260	-.019	-.647	.318	.038	.149	.017	.041
NOL		1	.858**	.845**	-.084	.056	.564	.109	-.001	-.237	.321	.111	.402
PLTH			1	.892**	-.359	.312	.554	.825**	-.274	.046	.547	.346	.630
NOI				1	.515	-.529	.093	-.111	.550	-.056	.390	-.182	.179
IL					1	-.992**	-.578	-.401	.994**	-.263	-.412	-.815**	-.643
DTF						1	.588	.317	-.995**	.331	.357	.810**	.600
NSV							1	.469	-.553	.380	.365	.546	.535
LA								1	-.367	-.033	.813**	.751**	.441
VL									1	-.317	-.374	-.814**	-.605
NOF										1	-.046	.088	.044
FWtP											1	.723*	.949**
FDP												1	.844**
FLP													1

D50E: Days to 50% emergence; NOL: number of leaves; PLTH: plant height; NOI: number of internodes; IL: Internode length; DTF: days to flowering; NSV: number of secondary vines; LF: leaf area; VL: vine length; NOF: number of fruits; FWtP: fruit weight; FDP: fruit diameter; FLP: fruit length per plant; * and ** are significant levels of *p* at 5% and 1%, respectively.

Conclusion

Pig and Poultry manure are indispensable components in soil fertility management. They are very rich in nitrogen, phosphorus, potassium and organic matter, and can be very useful in correcting low soil fertility by replenishing lost soil nutrients. The effect of corresponding levels of pig and poultry manure on growth attributes of watermelon including days to 50% emergence, number of leaves, leaf area, number of internodes, number of secondary vines, vine length and plant height were statistically similar, implying that one can conveniently substitute the other without any significant reduction in growth. However, significant difference was observed at corresponding levels of pig and poultry manure for yield attributes. Application of 5 t/ha of pig manure, and 10 t/ha poultry manure gave superior fruit length, average fruit weight, number of fruits per plant and yield per hectare, and were the best sole application rates. The combined effect of 5 t/ha pig manure and 10 t/ha poultry manure outperformed other manure combinations in yield attributes, and is thus recommended for higher yield. The most varied traits that can be used for characterization and selection studies in watermelon are internode length, fruit diameter, fruit length, vine length, number of days to flowering, number of secondary vines, number of leaves, number of internodes and fruit weight. Leaf area was significantly and positively correlated with fruit weight implying that fruit weight can be adequately predicted from leaf area with great precision. This makes lots of sense because the leaves contain chlorophyll molecules which are pigments associated with PSII photochemistry, such that the broader the leaf, the higher the quantum of light energy that is absorbed, and the higher the efficiency of photosynthesis relative to narrow leaves

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