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Research Article

Effect of Planting Rhizome Weight on Growth and Chemical Constituents of Turmeric Varieties

Mohamed M A, Mahfouz S A*, Ibrahim M E

Medicinal and Aromatic Plants Research Department, National Research Centre, El Buhouth St. 12622, Dokki, Cairo, Egypt.

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ABSTRACT

Curcuma sp, has an economic importance in several cases. This work was conducted to study the effect of weight of rhizome on growth, yield of turmeric, and its chemical components. Pieces of rhizomes with different weights were cultivated (10, 20, and 30g) of two varieties of *Curcuma* sp. (*Curcuma domestica* and *Curcuma aromatic*). Data revealed that, the pieces of the highest weight produced the stronger plants in the two varieties, so the highest weight of pieces produced the heaviest rhizomes. Also total carbohydrates, essential oil and curcumine yield markedly enhanced with the increasing in the weight of piece rhizome.

Keywords: Rhizome, Variety, Plant parameter, chemical constituents**.**

INTRODUCTION

Curcuma plant belongs to family zingibaracae. It is a genus of about 70 species of rhizomatous herbs of which a few are of economic importance[1]. *Curcuma domestica* and *curcuma aromatica* are a herbaceous perennial plants which consider one of the most valuable and important spices. India is the largest producer of turmeric in the world. The major chemical consists of pale yellow orange volatile oil, composed of a number of monoterpenes and sesquiterpenes including zingeberene, curcumene, α and β turmerone among others. The colouring principles (5%) are curcuminoids such as curcumin[2]. In geophytic and other vegetatively propagated plant growth, development and plant components are influenced by the amount of stored reserves present in the tuber, corm, rhizomes or blub at the time of planting, Bremner and El Saeed (1963)[3] on potato. Rees (1969)[4] on tulips found a higher yield of tubers from higher sets weights of white yam (Dioscorerotuneda). Rees (1985)[5] indicated that, there is a relationship between the reserves of the bulb scales and flower production, so, large bulb has higher vegetative growth than small bulbs.

Karim et al (1999)[6] found that, the highest yield of onion produced from a bulb with large size. Mosleh and Deen (2008)[7] suggested that, the large mother bulb of onion and early planting gave higher bulb and seed yield. The studies of Haydar *et al (*2007)[8] showed that the large bulbs of *Allium cepaL* had a positive effect on the height of plants, fresh weight of bulbs and their length. So, the aim of this work was to evaluate the effect of weight of rhizome on growth, yield of turmeric, and its chemical components.

MATERIAL AND METHODS

The experiment was conducted during the two successive seasons of 2010 and 2011 at the experimental farm of the faculty of Agriculture, Cairo University to study the effect of rhizome weight on the growth and yield of turmeric of *Curcuma domesteca* (C.d.)and *Curcuma aromatic* (C.a.) plants. Rhizomes of turmetic plant were obtained from the experimental farm of National Research Centre, Giza, Egypt. The experiment was a randomized complete block design with three replicates. Pieces of rhizomes of weights of 10 g, 20 g and 30 g with at least 2 eyes per piece were planted at spacing of 40 cm among plants in a ridges 60 cm aport. The rhizomes were cultivated on May 1st in both seasons.

Fertilizers were added and all agricultural practices were followed as recommended. The following parameters like plant height, number of leaves, width of leaf, fresh and dry weight of rhizomes per plant and per hectare were measured. Also the following analysis were done, such as total carbohydrate, curcumine and essential oil.. Total carbohydrates percentage in dried rhizomes was determined by using colorimetric method of Herbert et al (1971)[10]. The essential oil was isolated by hydro distillation for 3 hr according to Guenther (1961)[11]. The curcumin content in dry rhizomes was determined by HPLC. The data was statistically analysed according to Snedecor and Cochron (1990)[9].

RESULTS AND DISCUSSION

For the plant height, data in Table (1) showed that the heaviest the rhizome, the higher the plant height throughout the observation periods in both varieties *Curcuma domestica* and *Curcuma aromatica*. So the 30 g of piece rhizome produced the tallest plants (63.0) cm. Comparing to (42.82) cm produced from a pieces of 10 g

*Author for Correspondence: smahfouz68@yahoo.com

Table 1: Mean values of weight of piece rhizome and varital effects growth parameters (mean of two season).

Treatments	Plant hight	Leaves No.	Width of leaf	FW R/Plant (g)	DW	FW R yield/fed.(Kg) (Kg)	DW (g)
Mean values of Weight piece effect							
10g	42.83	4.33	8.5	23.45	6.897	618.67	182.12
20g	58.33	5	11.5	32.77	9.637	865.33	253.74
30g	63	5.33	14.33	49.12	14.438	1297.33	381.17
L.S.D.5%	3.14	0.38	0.61	2.62	0.77	67.37	19.6
Mean values of varieties effect							
C.d.	54	4.88	10.55	30.63	9.048	808.58	238.44
C.a.	55.11	4.88	12.33	39.59	11.6	1046.22	306.25
L.S.D.5%	N.S	N.S	0.49	2.14	0.63	55.01	16.01

R: Rhizome, FW: fresh weight, Dw: dry weight

Table 2: Interaction effects of weight of piece rhizome and varital effects on growth parameters (mean of two season).

Weight piece	Var.	Plant height	Leaves No.	Width of leaf	F.W. R/plant (g)	D.W.	F.W. R. yield/fed (Kg)	D.W.
	C.d.	40.7	4	7	21.7	6.41	570.67	169.2
10g	C.a.	45	4.7	10	25.2	7.39	666.67	195.3
	C.d.	59	5	11	30.2	8.92	797.33	234.16
20g	C.a.	57.7	5	17	35.3	10.35	933.33	273.33
	C.d.	63.3	5.7	13	40	11.82	1056	311.96
30g	C.a.	62.7	5	15	58.2	17.06	1538.67	450.39
L.S.D.5%		4.44	0.54	0.85	3.69	1.09	95.28	27.72

Table 3: Mean values of weight piece rhizome and varital effects on chemical constituents (mean of two season).

Treatments	Essential oil			Total carbohydrates			Total curcumine		
	ml./plant	ml./unit	L./fed.	g/plant	g/unit	kg/fed.	g/plant	g/unit	kg/fed.
Mean values of Weight piece effect.									
10g	0.08	3.35	2.68	3.12	102.99	82.4	0.03	0.94	0.75
20g	0.14	4.6	3.68	4.49	148.03	118.03	0.04	1.38	1.1
30g	0.19	6.14	5.05	7.1	234.14	187.31	0.15	1.87	1.5
L.S.D.5%	0.04	0.41	0.28	0.36	11.95	9.33	N.S	0.22	0.17
Mean values of varieties effect									
C.d.	0.11	3.56	2.94	4.43	146.19	116.96	0.04	1.17	0.94
C.a.	0.16	5.83	4.67	5.37	177.25	141.53	0.11	1.61	1.29
L.S.D.5%	0.03	0.34	0.23	0.29	9.76	7.62	N.S	0.17	0.14

weight the height of the plants in 10 g treatment was significantly lower than those from 30 g. For the number of leaves and leaf width, the data in the same table also showed that the plants in the treatment 30 g produced the higher number of leaves, followed by the 20 g treatment where as the lowest number was produced from 10 g treatment. For the effect of piece weight of rhizome on the leaf midth, the results had the same trend as in the number of leaves. The increase in the leaf width in the treatment of 30 g was about 40.68% than that of the 10 g treatment. For the fresh and dry weight of rhizomes per plant and feddan, the data in the same table also showed that, the increase in the piece weight of rhizome caused a significant increase in the weight of fresh rhizomes per plant and per feddan. The fresh weight of rhizome per plant was 49.12 g in the 30 g treatment and 23.45g in the 10g treatment. The fresh yield of rhizomes per feddan was 1297.33 kg in the treatment of 30g. And 618.67 kg for the treatment of 10 g for the dry weight of rhizomes per plant and faddan, it had the same manner as in the fresh yield.

For the effect of varieties on the previous parameters, the data in Table (2) also showed that *Curcuma aramotica* was the higher and the differences were significant in most cases in comparing to *Curcuma domestica*.For the effect of the interaction between the weight of piece of rhizome and the varieties of *Curcuma* sp., the data in the same Table (2) indicated that, the previous parameters were significantly affected by the change in the weight of rhizomes and the varieties treatments. Thus the various plant height, number of leaves, leaf width and fresh and dry weight of rhizomes in general changed under the various weight of piece rhizome and the varieties. The highest weight of rhizomes and the other parameters were recorded with the treatment of 30 g. Weight comparing to the treatment of 10 g weight. These changes were significant in most cases.

For the effect of the weight of pieces and the varieties on the plant chemical components, the data in table (3) revealed that, the highest of piece rhizome produced plants. The highest carbohydrate, essential oil and curcumine content. The data in the same table also showed

Table 4: Interaction effects of weight pieces and turmeric varieties on chemical constituents (mean of two season).

Weight piece	Var.	Essential oil				Total carbohydrates				Total curcumine			
		%	ml./ plant	ml./ unit	L./ fed.	%	g/ plant	g/ unit	kg/ fed.	%	g/ plant	g/ unit	kg/fed.
10g	C.d.	1.12	0.072	2.38	1.9	46.14	2.96	97.55	78.04	0.377	0.03	0.88	0.7
	C.a.	1.77	0.131	4.32	3.46	44.49	3.29	108.45	86.76	0.435	0.03	0.99	0.79
20g	C.d.	1.17	0.104	3.44	2.76	47.73	4.26	140.5	112.41	0.368	0.03	1.1	0.88
	C.a.	1.68	0.174	5.75	4.6	45.53	4.71	155.55	123.64	0.489	0.05	1.65	1.32
30g	C.d.	1.33	0.157	4.86	4.16	51.43	6.08	200.52	160.42	0.377	0.05	1.54	1.23
	C.a.	1.32	0.225	7.43	5.94	47.56	8.11	267.75	214.2	0.387	0.07	2.2	1.76
L.S.D.5%			0.05	0.58	0.39		0.51	16.89	13.19	13.19	N.S	0.3	0.24

that *Curcuma aromatic* variety gave the highest amounts of carbohydrates, essential oil and Curcumine in comparing to *Curcuma demostica*. The differences were significant in most cases.

For the combination effect between the weight of piece and the varieties, the data in table (4) also showed that, the analysis revealed that both varieties and the weight of piece had a remarkable and significant effect on both plant parameters and components. The larger the piece weight of rhizome, the higher the plant parameters and components throughout the experimental period. The varieties had the same effect as in the weight of piece rhizome.

DISCUSSION

Larger rhizomes contain a larger amount of reserves that enhanced growth, so the plants grown from the heaviest piece rhizome were the tallest. For the number of leaves, the differences were not so large because the plant seedlings emerged almost at the same time, but the leaf size was bigger when the seed was larger. After the initial stage the received a higher solar energy for photosynthesis, Sarker *et al.*(2001)[12] on the number of leaves increased as the seed size increased, because the plants from the large seed were stronger. The plants with larger leaf number rice. Shoot biomass of turmeric plants increased with increasing seed size in all experiments Singh and Singh (2003)[13]. Also, Santos *et al (*1997)[14] showed that shoot biomass of purple nutsedge was increased by increasing tuber weight up to 0.75g. The larger the piece of rhizome the higher turmeric yield in most of the experiments is due to the larger shoot biomass. These result was in accordance with that obtained by Hyadar *et al.* (2007)[8]. Stougard and Xue (2004)[15] stated that wheat yield markedly increased by the increasing in the size of seed. This results were in agreement with that obtained by Santos *et al.*(1997)[14] on purple nutsedge.

CONCLUSION

The trials in this experiment suggested that, in both varieties *Curcuma aromatica* and *Curcuma dometica*, the inerease in the weight of piece rhizome caused a significant increase in the plant parameters such as plant height, number of leaves, leaf width, and the fresh and dry yield of rhizomes per plant and per feddan. Also this study revealed that the highest weight of seed rhizomes produced plants had the highest yield of essential oils and curcumine.

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