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Research Article

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Spraying organic material to improve head yield and horticultural characteristics of summer cabbage (*Brassica oleraceae* var. *capitata*)

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Abstract This study was conducted for improve head yield and some horticultural characteristics by spraying summer cabbage (*Brassica oleraceae var. capitata*) with organic material (Vinas organic fertilizer), Treatments includes : without application (T1 or control), folair spraying with Organic material (2.5%) after 20 days of transplanting(T2), folair spraying with Organic material (2.5%) after 35 days of transplanting(T3) and folair spraying with Organic material (2.5%) after 50 days of transplanting(T4) with Vinas organic fertilizer, the results showed non-significant ($p>0.05$) effect of organic material in head diameter, head length, No. of leaves, No. of plant, No. of lost plant, weight of head, yield of plot, yield of hectare, length of outer leaves, width of outer leaves, length of inner leaves, width of outer leaves, Chlorophyll (%) in outer leaves, Chlorophyll (%) in inner leaves, Nitrogen (%) in outer leaves, Nitrogen (%) in inner leaves, wet weight (%) in inner leaves and dry weight (%) in inner leaves , while effect significantly ($p\leq0.05$) in Chlorophyll (%)in outer leaves, wet weight (%) in outer leaves and dry weight (%) in outer leaves. We can concluded that using of this organic material not affected in most of cabbage parameters, and not using may decreases the economic cost of this type of cabbage production.

Keywords *Brassica oleraceae*, Vinas organic fertilizer, horticultural characteristics

Introduction

Cabbage (*Brassica oleraceae*var. *capitata*) is one of the most important leavesy vegetables worldwide [1]. It originated in Northern Europe, the Baltic Sea coast [2] and the Mediterranean region [3], where it has been grown for more than 3000 years and is adapted to cool moist conditions [4-5]. Cabbage is cultivated for its head, which consists of water (92.8%), protein (1.4 mg), calcium (55.0 mg) and iron (0.8 mg).The optimum mean temperature for growth and quality head development is 15 - 18°C, with a minimum temperature of 4°C and a maximum of 24 °C. Cabbage grows well on a range of soils with adequate moisture and fertility. It tolerates a soil pH range of 5.5 - 6.8 and it is a heavy feeder. To maintain growth, cabbage requires a consistent supply of moisture, and should as a general rule receive a minimum of 2.5 cm of water per week. With proper management, cabbage can produce 25 - 30 t/ha. Cabbage heads are ready for harvest 80 - 120 days after germination, depending on genotype and climate [6].

The importance of head cabbage in tropical and subtropical regions has increased considerably in recent decades. Recent estimates indicate Africa has 100,000 ha planted with head cabbage. The purpose of foliar feeding is not to replace soil fertilization. Supplying a plant's major nutrient needs (nitrogen, phosphorus, potassium) is most effective and economical via soil application. However, foliar application has proven to be an excellent method of supplying plant requirements for secondary nutrients (calcium, magnesium, sulfur) and micronutrients (zinc, manganese, iron, copper, boron, and molybdenum), while supplementing N-P-K needs for short and/or critical growth 3 stage periods. Primarily, foliar feeding is intended to delay natural senescence processes shortly after the end of reproductive growth stages [7]. Foliar feeding targets the growth stages where

declining rates of photosynthesis and leveling off of root growth and nutrient absorption occur, in attempts to aid translocation of nutrients into seed, fruit, tuber or vegetative production. Secondarily, foliar feeding can be an effective management tool to favorably influence pre-reproductive growth stages by compensating for environmentally induced stresses of adverse growing conditions and/ or poor nutrient availability [8].
This study will be design to spraying summer cabbage (*Brassica oleraceae var. capitata*) with organic material (Vinas organic fertilizer) to improve head yield and some horticultural characteristics.

Materials and Methods

Experimental design:

This experiment was conducted in agricultural research center in Bakrajo, the experiment consist of:

1. No. of treatments were 4 treatments with four replicates
2. One block was 560 cm * 80 cm.
3. Blocks area were 4.48 m.
4. No. of transplants in each block were 15 plants for each block.
5. No. of plants harvested were 15 plants for each block.
6. Seeds from (JICA organization) were sowing to produce transplants and sowing date were 10/4/2015.
7. Time to first germination after 5 days 17/3/2015 start to germinate.
8. After forming 4-6 true leaves transplans were planting in plastic house and the planting date was 12/3/2015.9-Treatments includes : without application (T1 or control) , folair spraying with Organic material (2.5%) after 20 days of transplanting(T2), folair spraying with Organic material (2.5%) after 35 days of transplanting(T3) and folair spraying with Organic material (2.5%) after 50 days of transplanting(T4) with Vinas organic fertilizer (B&S pot Min- Liquid -which contain:30% organic matter, 0.5% organic Nitrogen,3% soluble potassium oxide K_2O and with pH=4-6) which manufactured by JAS-ANZ – company)
9. The plants were irrigated when they need to be watered by drip Irrigation.
10. Weeds were eradicated when they emerge by hand.

Parameter

- Chlorophyllcontent of outer & folded leaves. Chlorophyll percentage out of the gross pigments of folded and unfolded leaves were measured by Chlorophyll Meter (Model spad 502).
- Head length &Head width.
- Leaves length (cm)&Leaves width(cm).
- Total plant number &Loose Head (%)
- %N content of outer & folded leaves.

Stastical Analysis:

All data were subject to one-way analysis of variance (ANOVA) using XL Stat program for Windows. Differences between the means were tested by Duncan's multiple range tests. The level of significance was chosen at $P<0.05$ and the results are presented as mean [9].

Results and Ddiscussion

Cabbage is a cool season crop and as such does not perform well under high temperatures. The optimum temperature range for cabbage production is 15 to 20 ºC. Temperatures above 20 ºC delay maturity, increase vegetative growth (number of leaves), and lead to formation of loose heads, the organic material used to improving some of cabbage production parameter. Cabbage is known for its nutritional importance, it is rich in minerals and vitamins like A, B1, B2 and C [10].
The results of head diameter (Table, 1) showing non-significant differences ($p>0.05$) between treatments, the results of diameter records were 17.700, 17.500, 17.375 and 16.975 cm in cabbage of T3, T4, T2 and T1 respectively.
The results of head length for 4 treatments as showing in table (1), there were non-significant differences between treatments, the head length in cabbage of T1, T2, T3 and T4 were 13.580, 13.450, 13.300 and 13.125 cm respectively.
For the No. of leaves, results in table (1) showed non-significant differences between treatments, the results of No. of leaves were 9.600, 9.000, 8.400 and 8.350 recorded T4, T1, T3 and T2 respectively.
As show in table (1), the No. of plant results show non-significant differences ($p>0.05$) between treatments, the highest No. of plant records in T1, T2, T4 and T3 were 26.00, 24.500, 24.00 and 22.50 respectively.
No. of lost plant results showed non-significant differences ($p>0.05$) between treatments, No. of lost plant records in T2, T4, T3 and T1 were 4.00, 2.500, 2.250 and 2.00 respectively.

The yield of plot results recorded non-significant differences (p>0.05) between treatments, the yield were 22.577, 22.363, 19.688 and 18.270 kg/plot in cabbage of T1, T3, T4 and T2 respectively.
For the yield of hectare, the results show non-significant differences (p>0.05) between treatments, the yield were 50.419, 49.916, 43.945 and40.781 ton/ha records in cabbage of T1, T3, T2 and T4 respectively.
Cabbage varieties differ in their head and length and records between 10.0-11.0 cm when they grow in different plant populations as in Žnidarčič*et al*. (2007) [11], and there is a reduction in head weight was the cause for the difference in the head diameter. Head diameter generally increased with decreased plant spacing. Semuli (2005) [21] mentioned that it is possible that as plant spacing was reduced, competition for nutrients, light, air and moisture.
The results of head diameter of our study were lowest to the results of Khan *et al.*(2002) [10] and this may be due to that the cabbage which used in this study was the summer cabbage and in his study he used the cabbage as a winter crop.

Table 1: Effect of Vinas organic fertilizer on some Cabbage production parameters

Traits	Treatments T1	T 2	T 3	T 4
head Diameter	16.975±1.018 a	17.375±0.595 a	17.700±0.337 a	17.500±0.529 a
head length	13.580±0.641 a	13.450±0.275 a	13.300±0.442 a	13.125±0.325 a
No. of leaves	9.000±1.314 a	8.350±0.465 a	8.400±0.383 a	9.600±1.010 a
No. of plant	26.000±0.913 a	24.500±1.658 a	22.500±0.645 a	24.000±1.683 a
No. of lost plant	2.000±0.707 a	4.000±1.472 a	2.250±0.629 a	2.500±1.041 a
Yield (kg/plot)	22.588±2.691 a	18.270±3.551 a	22.363±1.196 a	19.688±2.314 a
Yield (ton/ha)	50.419±6.007 a	43.945±7.926 a	49.916±2.668 a	40.781±5.165 a

Means having different letters in the same row are significantly different (P<0.05) for each parameter.

As showing in table (2), there were non-significant differences (p>0.05) between treatments for length of outer leaves, the length recorded in cabbage of T2, T3, T1 and T4 were 40.00, 38.250, 38.00 and 36.750 cm respectively.
For the width of outer leaves results (Table, 2), the width recorded in cabbage of T3, T2, T1 and T4 were 41.00, 40.500, 40.00 and 37.750 cm respectively, with non-significant differences (p>0.05) between treatments.
The results of length of inner leaves showing non-significant differences (p>0.05) between treatments (Table, 2), the length recorded in inner leaves for T2, T4, T3 and T1 were 40.500, 38.500, 37.750 and 36.250 cm respectively.
For the width of outer leaves results (Table, 2), there were non-significant differences (p>0.05) between treatments, the results were 38.750, 40.500, 41.00 and 39.00 cm for T1,T2, T3 and T4 respectively.
Chlorophyll percentage in outer leaves results showing in table (2), Chlorophyll in T3 differ significantly (p≤0.05) among T2 and T4, while not differ with T1. The highest Chlorophyll percentage recorded in T3 (11.943%), while the lowest percentage recorded in T4 (7.996%).
Results of Chlorophyll percentage in inner leaves as showed in table (2), revealed that there were non-significant differences (p>0.05) between treatments, the Chlorophyll percentage were 6.012, 5.617, 5.282 and 5.250% in T1, T4, T2 and T3 respectively.
The Nitrogen (%) in outer leaves results showing non-significant differences between treatments (p>0.05)(Table, 2), the percentage of Nitrogen were 2.695, 2.535, 2.520 and 2.485% for T3, T4, T1 and T2 respectively.
There were non-significant differences (p>0.05) between treatments in results of Nitrogen (%) in inner leaves (Table, 2), the results for T1, T2, T3 and T4 were 3.290, 3.108, 3.080 and 3.038% respectively.
In two studying season the SPAD chlorophyll meter readings in cabbage were correlated with tissue total N concentrations determined by laboratory analysis at the heading stage and all growth stages [13].
Massa et al. (2015) (14) approved that chlorophyll content was greater than 30 SPAD units for all salad crops except 'Outredgeous' lettuce (28.7 SPAD units), which is indicative of low stress, and sufficient chlorophyll to support photosynthetic functions. 'Mizuna', Swiss chard, and both spinach varieties had very high chlorophyll

readings (>50 SPAD Units), while beet, Chinese cabbage, and 'Waldmann's Green' lettuce were intermediate, with values between 30 and 50 SPAD units.

These results ascompared to other researchers showed that the heads contain between 2.0-4.0 in each inner and outer leaves of the heads but in [15] heads contain nitrogen in a range between 3.0-4.0% when plant tissue are analysis and it somewhat near to this study.

It needs nitrogen in optimum amount; excessive amount of nitrogen may cause loose head formation and internal decay if nitrogen is not in adequate amount it would not form heads. The demand for phosphorus increases manifold during head formation stage. While potassium deficiency can result in marginal necrosis and retards head quality but it excess cause the head to open [10].

Table 2: Effect of Vinas organic fertilizer on some Cabbage production parameter

Traits	Treatments			
	T1	**T 2**	**T 3**	**T 4**
Length of outer leaves (cm)	38.000 ±1.080 a	40.000±3.391 a	38.250±2.869 a	36.750±1.109 a
Width of outer leaves (cm)	40.000±2.380 a	40.500±1.323 a	41.000±3.240 a	37.750±2.016 a
Length of inner leaves (cm)	36.250±0.629 a	40.500±3.708 a	37.750±2.287 a	38.500±1.190 a
Width of inner leaves (cm)	38.750±2.839 a	40.500±2.784 a	41.000±2.121 a	39.000±1.581 a
Chlorophyll (%) of outer leaves	9.542±0.4308 ab	8.609±1.3447 b	11.943±2.2929 a	7.996±1.2326 b
Chlorophyll (%) of inner leaves	6.012±0.3054 a	5.282±0.6152 a	5.250±0.5813 a	5.617± 0.3377 a
Nitrogen (%) in outer leaves	2.520±0.057 a	2.485±0.105 a	2.695±0.144 a	2.535±0.136 a
Nitrogen (%) in inner leaves	3.290±0.202 a	3.080±0.206 a	3.108±0.185 a	3.038±0.066 a

Means having different letters in the same row are significantly different (P<0.05) for each parameter.

The results of wet weight percentage in outer leaves showing in table (3), the T2 differ significantly (p≤0.05) among T3 and T4, and non-differ with the T1, while T1, T3 and T4 not differ between others. The highest wet percentage in outer leaves recorded in T2 (87.583%), while the lowest percentage recorded in T5 (85.540%).

For the wet weight percentage in inner leaves (Table, 3), there were non-significant differences (p>0.05) between treatments, the results for cabbage of T2, T1, T3 and T4 were 95.328, 94.734, 94.671 and 93.377% respectively.

The results of dry weight percentages in outer leaves showing in table (3), the dry weight percentage in outer leaves of T2 differ significantly (p≤0.05) with T3 and T4, and not differ with T1, while the T1, T3 and T4 not differ between other, the highest dry weight percentage recorded in T4 (14.460%), while the lowest percentage recorded in T2 (12.417%).

For the dry weight percentage in inner leaves (Table, 3), there were non-significant differences (p>0.05) between treatments, the results were 6.267, 5.329, 5.266 and 4.672% in cabbage of T4, T3, T1 and T2 respectively.

The dry weight effected by nitrogen uptake [16], the results in table (2) showing that highest nitrogen% recorded in inner leaves of T1 (3.290%), which effected on dry weight of this treatment.

Table 3: Effect of Vinas organic fertilizer on some Cabbage parameter

Treatments	Traits			
	Wet weight(%) of outer leaves	**Wet weight (%) of inner leaves**	**Dry weight (%) of outer leaves**	**Dry weight (%) of inner leaves**
T1	86.330±0.392 ab	94.734±0.260a	13.670±0.392ab	5.266±0.260a
T2	87.583±0.555 a	95.328±0.714a	12.417±0.555b	4.672±0.714a
T3	85.866±0.666 b	94.671±0.290a	14.134±0.666a	5.329±0.290a
T4	85.540±0.399 b	93.733±0.712a	14.460±0.399a	6.267±0.712a

Means having different letters in the same column are significantly different (P<0.05) for each parameter.

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