

**Growth and production of three potato cultivars as affected by  
organic foliar nutrition**

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**Abstract**

An experiment was carried out in private farm in Radwaniah , 30 km westernsouth of Baghdad to test the impact of foliar spray by two organic fertilizers( Humistar and Vegeamino ) at three concentrations ( 0 , 1.0 and 1.5 ml.L<sup>-1</sup> ) on three potato cultivars ( Ajiba , Riviera and Cardinal ) grade Elite . Plants were fertilized by using soil addition with N , P and K at rate of 120 : 60 : 200 kg.ha<sup>-1</sup> applied to the soil. Foliar spray was applied twice to drip point , first at 45 days and second at 65 days post planting . Split – plot experiment design experiment was implemented where 15 treatment in each replication and three replicates were used.

Results showed the domination of Ajiba cultivar plant length (88.42) cm and total leaf area (42.82)dm<sup>2</sup> . plant<sup>-1</sup> , while Riviera cultivar had in plant greatest number of the main stem(4.69 stem.plant<sup>-1</sup>) , number of marketable tubers (6.91 tuber. plant<sup>-1</sup>), average marketable tuber weight (115.74 g.tuber<sup>-1</sup>) and highest plant yield (834.12 g. plant<sup>-1</sup>) .

On the other hand foliar spraying treatments of organic fertilizers, revealed that humistar at  $1.5 \text{ ml.L}^{-1}$  improved all vegetative growth and yield parameters as compared to other organic fertilizers treatments .

Interaction was significant where spraying Riviera cultivar by  $1.5 \text{ ml.L}^{-1}$  of humistar had greatest number of stems  $5.58 \text{ stem . plant}^{-1}$  , number of marketable tubers  $8.14 \text{ tuber.plant}^{-1}$  , average of marketable tuber weight  $123.67 \text{ g.tuber}^{-1}$  , plant yield  $1027.11 \text{ g. plant}^{-1}$  and highest marketable yield  $53.69 \text{ ton.ha}^{-1}$  .

This conclusion from here on was left humistar at  $1.5 \text{ ml . L}^{-1}$  as foliar spray twice ( 45 and 65 days post. planting ) is suggested to be used on potato plants to improve growth and increase marketable and healthy yield.

Key word : Foliar nutrition , Organic fertilizer , marketable yield.

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## **Introduction**

Potato (*Solanum tuberosum* L.) is one of most important vegetables belongs Solanaceae Family (II). It is very important in human food because of its features as high nutrients content and energy source. Because of increasing world population, the food demand was increased and potato had fourth rank of strategic economic crop after wheat, rice and corn (8). In Iraq, the productivity of potato is low as compared to the worldwide countries such as Holland and France. The total area planted by potato in Iraq 6122 ha with total production 162915ton (i.e. 26.60ton.ha<sup>-1</sup>)(5). Recently attempts were taken to improve potato productivity in Iraq, cultivars with high productivity were imported and cultural practices were optimized including supplementation of required nutrients to the plant both soil and foliar application. Absorption of foliar applied nutrients is faster and

keeping of leaching or fixation if soil applied. In addition, foliar nutrition could be practiced several times according to the plant growth stage(14).

Use of organic fertilizers had important impacts on growth and production of many crops, moreover, it is safe and environmentally friendly(7). Hanshal *et. al.*(10) found that foliar spraying of Bepton on Desiree cv. Potato at 0.5ml.L<sup>-1</sup> resulted in greater leaf area, average of marketable tuber weight and higher yield as compared to other organic fertilizer Biohorm on Avalon, Desiree and Arizona potato cultivars. In an experiment on four potato cultivars (Arizona, Riviera, Ambition and Lusa) and two foliar organic fertilizers (Alexin and Tronver) at three concentrations, the cultivar Ambition was dominated when sprayed with tronver at 3ml.L<sup>-1</sup> in number of stems, number of marketable tubers and plant yield(18).

This research aimed to examine the impact of organic fertilizer foliar spray (hamistar and vegeamino) on growth and productivity of three potato cultivars(Ajiba , Riviera and Cardinal ).

### **Materials and Methods**

An experiment was conducted at a private farm in Radwaniah , 30 km western south of Baghdad to verify the effect of foliar spray of two organic fertilizers ( hamistar and vegeamino ) on growth and yield of three grade Elite potato cultivars [ Ajiba (  $v_1$  ), Riviera (  $v_2$  ) and Cardinal (  $v_3$  ) ], where potato seed tubers were imported for spring season planting . Potato seed tubers were planted in furrows 4.5m length, 0.75m between furrows and 0.25cm between tubers . Each

experimental unit composed of two furrows with 36 plant . All agricultural practices including weeding , irrigation and ridging were uniformly done to all experimental units . Chemical fertilizer N , P , K was soil applied at rate of 120 : 60 : 200 kg.ha<sup>-1</sup>( 1 ) . Organic fertilizer were sprayed twice to drip point early in the morning and 0.01 % zahi as surfactant was applied , first 45 days post plating ( Tuber initiation stage ) and the second 65 days post planting ( Tuber bulking stage ) .The concentrations of the organic fertilizer ( humistar or Vegeamino ) were 0 , 1 and 1.5 ml.L<sup>-1</sup>referred to as cont , Hum , Hum2 or Veg1 andVeg2 respectively . Nutrient content of organic , fertilizers were as in Table 1.

**Table 1 . composition of organic fertilizer used .**

Humistar	Content humic acid 13.2% , total humic extract 16.5% , fulvic acid 3.3% and potassium 5.5%
Vegeamino	Content amino acids 24.8% , Organic nitrogen 4.77% N-NH <sub>4</sub> 0.04 and total nitrogen 4.81%

Experiment adopted was in Randomized Complete Block Design ( R.C.B.D ) as a Split – plot design where cultivars were main plots while type and concentration of organic fertilizer as sub – plot .

Treatment means were compared according to least significant differences(L.S.D)at probability 0.05(3). To evaluate Vegetative

growth characteristics ten plants from the middle region of the furrows were chosen and plant length was measured from soil surface to the top of tallest stem(cm.). Total leaf area( $\text{dcm}^2.\text{plant}^{-1}$ ) was calculated according to the following equation through the relationship between leaf area and dry weight(20).

$$\text{Total leaf area (dcm}^2.\text{plant}^{-1}) = \frac{\text{leaf area sample X total leaves weight}}{\text{Dry weight of the sample}} \dots (20)$$

Number of main stems grown from the tuber was calculated for each of the chosen plants. Yield and yield components included number of marketable tubers per plant where injured infected, and diameter less than 2.5cm were excluded(2). Average marketable tuber weight (g) ,plant yield( $\text{g}.\text{plant}^{-1}$ ) and marketable and total yield( $\text{ton}.\text{ha}^{-1}$ ) where the yield of experimental unit was used and related to hectare .

## **Results and Discussion**

Results in Table,2 revealed that Ajiba cv was the tallest plants and greatest total leaf area compared to other two cultivars ( 88.42cm,  $42.82\text{dcm}^2.\text{plant}^{-1}$ )respectively, while Riviera had the greatest number of main stems( $4.69\text{stem}.\text{plant}^{-1}$ )and differences were significant compared to cardinal cv. only.

Treatment of foliar application of organic fertilizers showed that humistar at concentration of  $1.5\text{ml}.\text{L}^{-1}$  had the highest values of vegetative characteristics as compared to other concentration

and the other fertilizer while non-sprayed plants(control) had the lowest values of same characteristics.

Interaction was significant where Ajiba cv. sprayed by humistar at concentration of 1.5ml.l<sup>-1</sup> had the tallest plants(98.17cm) and greater total leaf area(47.26 dcm<sup>2</sup>.plant<sup>-1</sup>), whereas greater number of main stem found in riviera cv. sprayed with the same fertilizer and concentration (5.58 stem.plant<sup>-1</sup>). control plants of riviera had the shortest plants(53.48cm) and smallest total leaf area (31.78 dcm<sup>2</sup>.plant<sup>-1</sup>), while lowest number of main stems found in control plants of Cardinal cv.(3.32 stem.plant<sup>-1</sup>).

Data in Table,3 showed significant differences between cultivars and fertilizers treatments in yield and yield components. Riviera cv. had greater number of marketable tubers (6.91tuber.plant<sup>-1</sup>) with highest average weight(115.74g.tuber<sup>-1</sup>), highest plant yield (834.12g.plant<sup>-1</sup>) and

greater marketable yield(42.98ton.ha<sup>-1</sup>) compared to Cardinal cv. which gave the lowest values(5.93 tuber. plant<sup>-1</sup>, 104.58g.tuber<sup>-1</sup>, 655.70 g.plant<sup>-1</sup> and 33.36 ton.ha<sup>-1</sup>) respectively. Foliar organic fertilizers treatment revealed the domination of Humistar at concentration of 1.5 ml. L<sup>-1</sup> on other treatments in yield and yield components and gave 7.46 tuber.plant<sup>-1</sup>, 117.49g.tuber<sup>-1</sup>, 899.60g.plant<sup>-1</sup>and 46.87 ton.ha<sup>-1</sup> for number of marketable tubers, average of marketable tuber weight, plant yield, plant yield and total yield per hectar respectively. However, non-treated plants had the lowest values of above traits(4.91 tuber.plant<sup>-1</sup>, 100.18 g.tuber<sup>-1</sup>, 539.83g .plant<sup>-1</sup> and 26.30 ton.ha<sup>-1</sup>) respectively.

**Table 2 . Effect of organic fertilizers on vegetative growth parameters in three potato cultivars**

Treatments	Plant length (cm)	Leaf area dcm <sup>2</sup> .plant <sup>-1</sup>	Number of Main.stems.plant <sup>-1</sup>
Cultivars			
Ajiba cv.V <sub>1</sub>	88.42	42.82	4.64
Riviera cv.V <sub>2</sub>	70.10	36.20	4.69
Cardinal cv.V <sub>3</sub>	84.34	40.39	4.18
L.S.D 5%	1.88	1.01	0.13
Fertilizer Treatments			
Cont	63.25	33.39	3.56
Hum1	81.02	39.76	4.31
Hum2	90.80	44.62	5.29
Veg1	81.30	38.61	4.25
Veg2	88.40	42.65	5.10
L.S.D 5%	1.17	0.79	0.09
Interaction between Cultivars and Fertilizer treatments			
V <sub>1</sub> cont	68.72	35.13	3.61
V <sub>1</sub> hum1	89.44	42.94	4.51
V <sub>1</sub> hum2	98.17	47.26	5.36

V <sub>1</sub> Veg1	90.58	42.35	4.48
V <sub>1</sub> Veg2	95.20	46.42	5.22
V <sub>2</sub> cont	53.48	31.78	3.76
V <sub>2</sub> hum1	73.46	36.15	4.33
V <sub>2</sub> hum2	79.66	40.09	5.58
V <sub>2</sub> Veg1	69.70	35.12	4.42
V <sub>2</sub> Veg2	74.18	37.86	5.37
V <sub>3</sub> cont	67.54	33.25	3.32
V <sub>3</sub> hum1	80.15	40.18	4.10
V <sub>3</sub> hum2	94.56	46.52	4.94
V <sub>3</sub> Veg1	83.62	38.35	3.85
V <sub>3</sub> Veg2	95.82	43.66	4.73
L.S.D 5%	2.31	1.44	0.18

Significant interactive treatments in yield and yield components where Riviera cv. sprayed by Humistar at concentration of 1.5 mL.L<sup>-1</sup> produced higher number of marketable tubers(8.14 tuber.plant<sup>-1</sup>), greater average tuber weight(123.67 g.tuber<sup>-1</sup>), plant

yield (1027.11 g.plant<sup>-1</sup>) and total yield(53.69 ton.ha<sup>-1</sup>), control plants of cardinal cv. on the other hand, had the lowest values of yield and yield components(4.69 tuber.plant<sup>-1</sup>, 93.25g.tuber<sup>-1</sup>, 486.75g.plant<sup>-1</sup> and 23.33ton.ha<sup>-1</sup>) respectively.



**Table 3 . effect of organic fertilizers on yield and yield components of three potato cultivars**

Treatments	Number of marketable tuber. plant <sup>-1</sup>	Average of marketable tuber weight ( g )	Plant yield ( g . plant <sup>-1</sup> )	Marketable yield ( ton.ha <sup>-1</sup> )
Cultivars				
Ajib cv V <sub>1</sub>	6.64	109.45	739.53	37.95
Riviera cv V <sub>2</sub>	6.91	115.74	834.12	42.98
Cardinal cv V <sub>3</sub>	5.93	104.58	655.70	33.36
L.S.D 5%	0.07	3.11	19.75	1.13
Fertilizer treatments				
Cont	4.91	100.18	539.83	26.30
Hum1	6.31	112.29	734.45	37.89
Hum2	7.46	117.49	899.60	46.87
Veg1	6.30	107.69	709.05	36.29
Veg2	7.21	111.98	832.62	43.14
L.S.D 5%	0.09	2.34	15.57	0.87
Interaction between Cultivars and Fertilizer treatments				
V <sub>1</sub> cont	4.92	100.83	541.90	26.45
V <sub>1</sub> hum1	6.30	112.12	729.53	37.66

V <sub>1</sub> hum2	7.52	115.70	890.06	46.38
V <sub>1</sub> Veg1	6.45	107.05	718.60	36.84
V <sub>1</sub> Veg2	7.13	111.56	817.56	42.43
V <sub>2</sub> cont	5.13	106.45	590.70	29.13
V <sub>2</sub> hum1	6.78	119.22	832.05	43.14
V <sub>2</sub> hum2	8.14	123.67	1027.11	53.69
V <sub>2</sub> Veg1	6.85	112.18	797.70	41.05
V <sub>2</sub> Veg2	7.66	117.20	923.07	47.94
V <sub>3</sub> cont	4.69	93.25	486.75	23.33
V <sub>3</sub> hum1	5.84	105.52	641.80	32.87
V <sub>3</sub> hum2	6.70	113.10	781.65	40.54
V <sub>3</sub> Veg1	5.60	103.83	610.73	31.02
V <sub>3</sub> Veg2	6.83	107.18	757.38	39.06
L.S.D 5%	0.15	4.30	28.20	1.58

Results in Table,2 referred to significant differences between potato cultivars under consideration in vegetative parameters where Ajiba had tallest plants and greater total leaf area while Riviera had the greater

number of main stems. These differences were expected due to the differences in the genetic makeup of each cultivar. Spraying organic fertilizer( Humistar and Vegeamino ) improved the vegetative growth parameters and

this reflected positively on yield and yield components. The positive effects of these fertilizers could be due to the composition of them . Vegeamino foliar application improved growth and production regardless potato cultivar and this may be due to the amino acids and nitrogen content .

May be most of plant metabolism affected by these components through the participation in proteins, enzymes, growth hormones, porphyrins of chlorophylls and cytochromes those directly involved in photosynthesis and respiration(13). Also may be Increasing chlorophylls content would increase the production of carbohydrates in plant and increase cell division and elongation so increase plant canopy and branching(12). Increased plant hormones particularly auxins may be will be a trigger to promote cell division and elongation so increase vegetative growth traits(9). Increasing vegetative growth

size(Table,2) finally will increase yield and yield components in potato(16). Results of Table,3 also show that spraying of organic fertilizer Humistar increased yield and yield components greater than organic fertilizer vegeamino . This may be due to the humic acids ( humic and fulvic ) and both acids would may increase nitrogen , phosphorus and potassium concentration in plant. Increasing content in plant would increase protoplasm mass and cell division so vegetative growth was increased(19). phosphorous on the other hand is a component of many organic compounds in plant that involved in plant biochemical metabolism such as photosynthesis , respiration and carbohydrates and fatty acids metabolism(4). High content of potassium in Humistar fertilizers ( 5.5% K )(Table,1) will increase plant content of this mineral. potassium have several roles in plant, it facilitate translocation of assimilates from leaves to other plant parts

including storage parts such as tubers(17).

Number of enzyme may activated by potassium including protein synthesis(15). Increasing plant canopy due to organic fertilizers spray increased plant capacity of sunlight harvest so accumulation of assimilates was increased and trans located from source(leaves) to sink(tubers)(21).

It can be concluded according to above results that both fertilizers had great impact on growth , and productivity of potato plants in all three cultivars but Humistar was more effective than Vegeamino probably humic substances may have hormone like substances(6).

Accordingly it can be suggested that spraying Humsitar at concentration of 1.5 ml.L<sup>-1</sup>twice at tuber initiation(45 days post planting) and tuber bulking stage(65 days post planting) to improve potato plant growth and productivity .

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