Effect of intercropped and micro nutrient fertilizers for *Cucurbita pepo* L. And *Cucumis sativus* L. On water productivity and yield under drip irrigation system

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Abstract:

Field experiment was carried out during spring season of 2017 in **the field of Agricultural Collage- University of Baghdad/** Al - Jadriya., Iraq in silt loam calcareous soil to study the effect of micronutrients and water amount applied to intercropped *Cucurbita pepo* and *Cucumis sativus* on yield and water use efficiency. *Cucurbita pepo* (Pumpkin) (synthetic cv. US, Agriseed, Fadwa) and *Cucumis sativus* (cucumber) *(*synthetic cv. *Kazear)* were planted monocropping and a strip intercropped. The experiment was a Split Plot Design arranged in RCBD with three replications. micronutrients treatment represents the main plot and intercropping system treatment as sub plot. Micronutrients treatments included application of 3 rates 0, 150 and 250 g 1000 m^{-2}. Monocropping for Pumpkin and cucumber were planted one line in treatments unit, while Intercropping for Pumpkin and cucumber were planted two line for any one in treatment units. All plots were irrigated with river water (ECi =1.45 dS m^{-1}), and irrigation was imposed at 35% depletion of available water using drip irrigation system.

Results indicated that number of irrigations were 40,41 and 39 for monocropping of *Cucurbita pepo*, *Cucumis sativus* and intercropping irrigation systems consuming 410 and 425 and 440 mm for the three treatments, respectively. All growth and yield parameters were no significantly at or/and at monocropping compared to intercropping. The interactions effect between the amount of micronutrient and water on fruits yield indicated that the best two treatments were 250 g 1000 m^{-2} with mono or/and intercropping (the best overall treatment and no significant with 150 g 1000 m^{-2}), and Values of IWUE for intercropping are almost more than monocropping

Key words: Intercropping, Micronutrients Fertilizer, *Cucurbita pepo* and *Cucumis sativus*), Water Productivity.

تأثير الزراعة المتداخلة والتسميد بالمغذيات الصغرى لقرع الكوسه والخيار في انتاجية المياه والحاصل تحت نظام الري بالتنقيط

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المستخلص:

نفذ البحث في حقل التجارب التابع لكلية الزراعة / جامعة بغداد في منطقة الجادرية في الموسم الربيعي 2017 في تربة كلسية ذات نسجة مزيجة غرينية لمعرفة التسميد بالمغيات الصغرى وكميات المياه المضافة لنظام الزراعة المنفردة والمتداخلة لقرع الكوسه والخيار في الحاصل وكفاءة استعمال المياه. طبقت التجربة بحسب توزيع الالواح المنشقة وفق تصميم القطاعات الكاملة المعشاة بثلاث مكررات، شملت عاملين: الاول التسميد بالمغذيات الصغرى والتي احتلت العامل الرئيس بثلاث مستويات 0 و150 و250 غم 1000م$^{-2}$ والثاني معاملات الزراعة والتي اخذت العامل الثانوي وتضمنت الزراعة المنفردة لكل من قرع الكوسه والخيار كلا على حده والتي كانت بخط واحد والزراعة المتداخلة لقرع الكوسه والخيار وكانت الزراعة بخطين احدهما لقرع الكوسه والاخر للخيار. جميع المعاملات تم ريها بمياه النهر ذو ايصالية كهربائية 1.45 ديسيسيمنز م$^{-1}$ والري عند استنفاد 35% من الماء الجاهز وتحت نظام الري بالتنقيط.

بلغ عمق مياه الري المضافة 410 و425 و440 مم وبعدد ريات 40 و41 و39 رية لكل من الزراعة المنفردة لقرع الكوسه والخيار والزراعة المتداخلة لقرع الكوسه والخيار، على الترتيب. جميع معايير النمو لم تختلف معنويا و/أو عند الزراعة المنفرده لكل من قرع الكوسه والخيار كل على حده والزراعة المتداخلة لقرع الكوسه والخيار واعطى مستوى التسميد 250 غم 1000م$^{-2}$ والذي لم يختلف معنويا عن مستوى التسميد 150 غم 1000 م$^{-2}$ افضل مؤشرات للنمو والحاصل وكفاءة استعمال الماء الحقلي في نظام الزراعة المنفردة و/أو الزراعة المتداخلة.

كلمات مفتاحية: الزراعة المتداخلة، التسميد بالمغذيات الصغرى، قرع الكوسه، الخيار، انتاجية المياه

Introduction:

Intercropping is the growing of two or more crops within the same or an over-lapping growing season within the same field. Intercropping can give more stable yields, better nutrient recycling in the soil, better control of weeds, pests and diseases

and an increased biodiversity. Cereals and legumes, both for forage and for grain, are the most common intercrops. In intercropping system careful planning is required, taking into account the soil, climate, crops, and varieties , and it is particularly important not to have crops competing with each other for physical space, nutrients, water, or sunlight (12).

Micronutrients are nutrients required by organisms throughout life in small quantities to orchestrate a range of physiological functions (4). For people, they include dietary trace minerals in amounts generally less than 100 milligrams per day, as opposed to macro minerals, which are required in larger quantities. The micro minerals or trace elements include at least iron, cobalt, chromium, copper, iodine, manganese, selenium , zinc and molybdenum. Micronutrients also include vitamins, which are organic compounds required as nutrients in trace amounts (9) .

One of the greatest effects that intercropping can have is on soil water management through the growing season (6). Intercrops have been shown to substantially improve water use efficiency (WUE). If intercropping were to be practiced, there would be a higher coverage of the soil by the second crop and a sort of green or living mulch would be formed and this would then also increase the WUE of the combined crop (10). Proper nutrition is essential for satisfactory crop growth and production. The use of soil tests can help to determine the status of plant available nutrients to develop fertilizer recommendations to achieve optimum crop production. The profit potential for farmers depends on producing enough crop per acre to keep production costs below the selling price. Efficient application of the correct types and amounts of fertilizers for the supply of the nutrients is an important part of achieving profitable yields (4).

There is very little information regarding optimum micronutrients doses for *Cucurbita pepo* L. intercropped with *Cucumis sativus* L.in Iraq especially when water is scarce. Hence, it is important to estimate the micronutrients and water demands of intercropped. Therefore, this study aimed to investigate the effect of level of micronutrients and water applied on the crops and water productivity of intercropped *Cucurbita pepo* and *Cucumis sativus.*

Material and Methods:

The experiment was carried out during spring seasons of 2017 in **the field of Agricultural Collage- University of Baghdad/ Al - Jadriya**. Some soil properties (Table 1) were determined according to methods described in (3, 5).

Cucurbita pepo (Pumpkin) (synthetic cv. US, Agriseed, Fadwa) and *Cucumis sativus* (cucumber) *(*synthetic cv. *Kazear)* were transplanted manually, at a depth of 2-5 cm on 10/March/ 2017, and calculated harvested of the sum fruits in a cumulative. The experiment was a Split Plot Design with Randomized Complete Block Design (RCBD) with three replications. Micronutrients treatment represents the main plot

and intercropping systems treatment as sub plot. Micronutrients treatments included application of 3 rates 0, 150 and 250 g 1000 m^{-2}, using Nutri Bubble contended: (K_2O = 12.4%, Zn-EDTA = 2.35%, Cu-EDTA = 0.15%, Fe-EDTA = 0.18%, Mn-EDTA = 2.44%, Mo = 0.04%, B_2O_3 = 4.4% and Mg = 1.35%). Monocropping for Pumpkin and cucumber were planted one line in treatments unit, while Intercropping for Pumpkin and cucumber were planted two line for any one in treatment units.

Table 1: Some chemical and physical soil properties

Properties	Unit	Value
pH	---	7.32
EC(1:1)	dS m^{-1}	2.31
Organic matter	gm kg^{-1}	15.16
Available N	mg kg^{-1}	47
Available P		21.81
Available K		151.4
Sand	gm kg^{-1}	312
Silt		480
Clay		208
Texture		Silt loam
Bulk density	Mg m^{-3}	1.32
Water content at FC	$cm^3.cm^{-3}$	0.39
Water content at WP		0.123
Available water		0.267

Irrigation was imposed at 35% depletion of available water using drip irrigation system. Nitrogen, phosphorus and potassium fertilizer application as the requirement for Pumpkin and cucumber in monoculture agriculture according to recommendation of Agriculture ministry. Experimental plots were 4.5 m^2 and plants spaced 0.25 m. All unit treatments applied humic acid at rate 15 kg $hectar^{-1}$. Plots were separated 2 m from each other. Fertilizers were placed in bands on the side of each row and covered by soil (side dressed). Weeds and all the required farming management were done as recommended.

All plots were irrigated with well water (ECi =1.4 dS m^{-1}). The soil depth of the effective root zone is increased from 0.15 m at planting to 0.30 m at Vegetative growth and the stage of fruit formation. Irrigation system was drip irrigation (using GR dripper) through line pipe provided with meter gages for measuring water applied. Soil water content was measured gravimetrically. All the indicators for evaluating the performance of the irrigation system were used such as distribution uniformity and application efficiency according to (2, 8), and water productivity (1) was calculated according to the following equation:

$$water\ productivity\ (WUE) = \frac{Yield\ (kg\ ha^{-1})}{total\ water\ applied\ (mm)} \dots\dots\dots\dots\dots (1)$$

Sub sample of 10 plants was taken from each plot to measure plant height (cm), leaves area (cm^2). Least significant differences (LSD) were used to differentiate means at the 0.05 level (10).

Result and Discussion:

Results of water applied are presented in Fig.1. It is appeared that number of irrigations were 40,41 and 39 for monocropping of *Cucurbita pepo*, *Cucumis sativus* and intercropping irrigation systems consuming 410 and 425 and 440 mm for the three treatments, respectively. The no differences in the amount applied are due to the convergence of water depth applied for both crops and to role of intercropping in reducing water depth consumed.

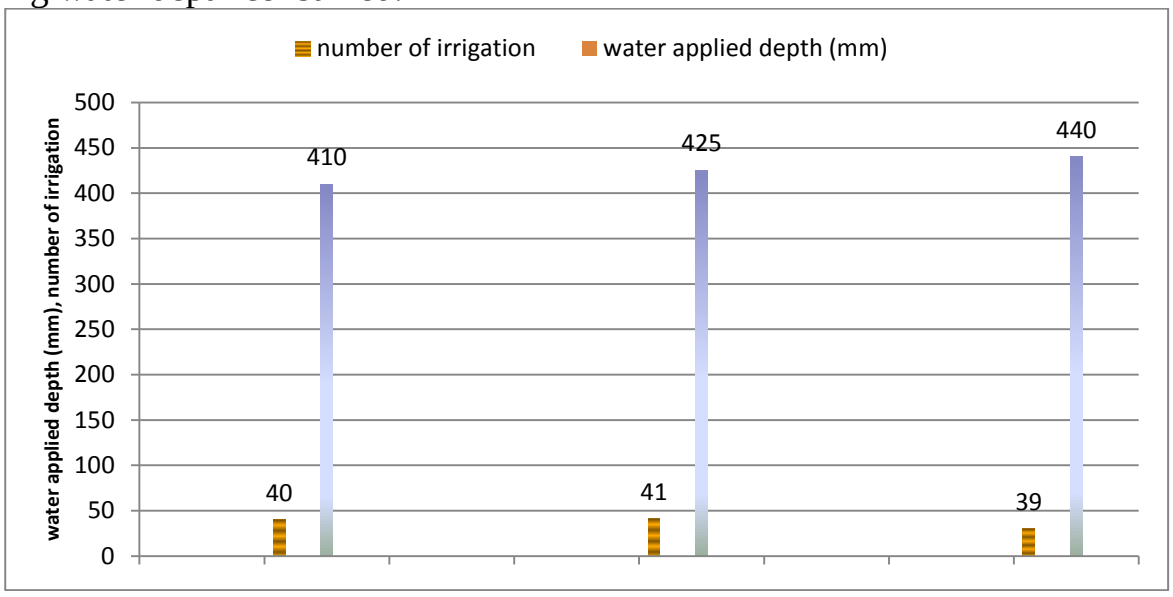

Figure 1: The mean water applied depth and number of irrigation for mono and intercropping agriculture systems.

Effects of rates of micronutrients and intercropping system on growth and yield of *Cucurbita pepo* and *Cucumis sativus* were presented in Table 2. All growth and yield parameters were no significantly at or/and at monocropping compared to intercropping. This can be due to the quantity of water used that enough to give the optimum yield during the growing season. Besides the application of humic acid in the field (15 kg ha^{-1}) help to improved good nutrition environmental lead to gave best growth parameter for intercropping system. as well as the increase plant density by planted two line in intercropping system leads to increase in yield and no significant differences than monocropping. Studies of water requirements for *Cucurbita pepo* or/and *Cucumis sativus* under surface irrigation of calcareous soil are very limited if any.

Generally speaking and as a main effect of micronutrient on growth and yield of *Cucurbita pepo* and *Cucumis sativus* the rate 250 g 1000 m^{-2} was the best for all pa-

rameters (with no significant differences than 150 g 1000 m^{-2}). The results show that can possibly due to the role of micronutrients in the experiment and the surrounding conditions.

Table 2: Effect of different levels of micronutrients fertilizers, mono and inter-cropping agriculture systems on plant height, leaves area and pod yield

Treatment	Plant Height (cm)	leaves area (m^2 $plant^{-1}$)	Fruit Yield Kg ha^{-1}
Monocropping (*Cucurbita pepo*)			
0	**75.86**	0.88	17695
150	**80.12**	1.12	19944
250	**83.56**	1.19	20378
Monocropping (*Cucumis sativus*)			
0	**88**	**1.82**	**18776**
150	**95**	**2.12**	**20856**
250	**110**	**2.31**	**21245**
Intercropping for Cucurbita pepo			
0	**72.65**	**0.84**	**17243**
150	**78.34**	**1.13**	**19965**
250	**82.12**	**1.15**	**20145**
Intercropping for *Cucumis sativus*			
0	**85**	**1.76**	**18256**
150	**91**	**2.04**	**20546**
250	**107**	**2.18**	**20865**
LSD	**1.87**	**0.152**	**576**

The interactions effect between the amount of micronutrient and water on fruits yield indicated that the best two treatments were 250 g 1000 m^{-2} with mono or/and intercropping (the best overall treatment and no significant with 150 g 1000 m^{-2}). Therefore, it seems to be the amount of water affected significantly the response to micronutrients applied. The interaction between water and micronutrients was reflected on water productivity (water use efficiency "WUE) (Fig.2). Average values were 4.15, 4.67, 4.74 ; 3.92, 4.54, 4.58; 4.42, 4.91, 5.00 and 4.32, 4.84, 4.97 kg m-3 for monocropping and intercropping of *Cucurbita pepo* or/and *Cucumis sativus*, at added micronutrient at rate 0, 150 and 250 g 1000 m^{-2} respectively. Values of IWUE for intercropping are almost more than monocropping. The reason of having higher IWUE for intercropping treatment is related to the nearly or equal quantity of irrigation water applied to intercropping in comparison with other treatments.

A high percent of the micronutrient requirements are taken up during the first one third of the growing period. Therefore, it is important to apply these micronutrient before or planting to get maximum utilization (we application micronutrient fertilizers twice in beginning and middle of growth stage).

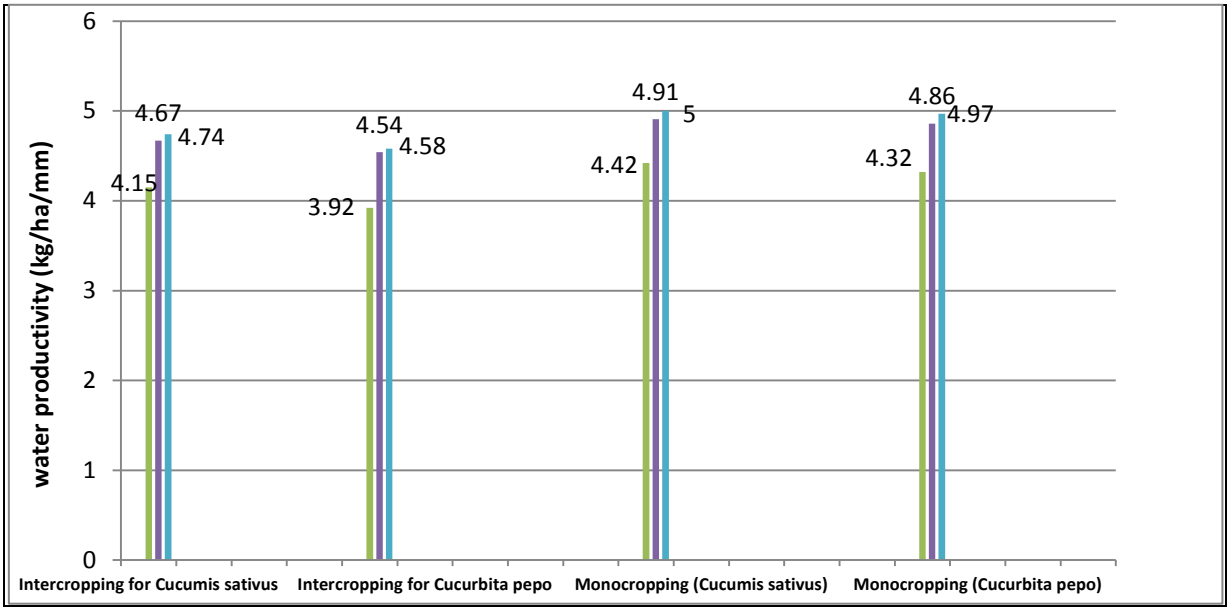

Figure 2: The water productivity for mono and intercropping systems.

Conclusion:

we can conclude that intercropping can be very useful practice especially when good practices water management and application of organic fertilizers to all field area with micronutrients.

References:

1. **Allen, R.G.; Perira, L.S.; Raes, D. and Smith, M. (1998)** Crop Evapotranspiration. *FAO Irrigation and Drainage paper* 56, Rome.
2. **Anderson, C.L; Bishop, A.A.; Hotes, F.; Keller, J.; Miller, J.A.; Pinney, J. and Smerdon, E. (1978)** Describing irrigation efficiency and uniformity. *Journal Irrigation Drainage* .104:35-41.
3. **Black, C. A.(1965)** *Methods of Soil Analysis*. Physical & mineralogical properties. Madison, Wisconsin, USA.
4. **Canadian UNICEF Committee. (2006)** *Global Child Survival and Health*. Academic Press, pp. 67.
5. **Page, A.L.; Miller, R.H. and Keeney, D.R. (1982)** *Soil Analysis*. Part 2 chemical and microbiological properties. ASA, SSSA .Madison, Wisconsin, USA.
6. **Rusinamhodzi, L., Murwira, H.K. and Nyamangara, J. (2006)** Cotton-cowpea intercropping and its N_2 fixation capacity improves yield of a subsequent

maize crop under Zimbabwean rain-fed conditions. *Plant Soil*, 287:327–336.

7. **SAS. (2010)** Users guide, Statistics SAS, Inst. Gary, N.C., U.S.A
8. **Schneider, A.D.; Evett, S.R.; Howell, T.A., Wanjura, D.F. and Upchurch, D.R.. (2000)** Automatic drip irrigation of corn and soybean. *Proceedings of the 4th decennial national irrigation*, Pp. 401-408.
9. **Vitamins and minerals. (2016)** *US Department of Agriculture, National Agricultural Library*. Retrieved 18 April.
10. **Walker, S., and Ogindo, H.O. (2003)** The water budget of rain fed maize and bean intercrop. *Physics and Chemical Earth*. 28:919–926.
11. **Yang, F., Xiaochun W., Dunping L., Fengzhi L., Rencai G., Weiguo L., Taiwen Y., Xiaoling W., Junbo D., Jiang L., and Wenyu Y. (2015)** Yield Response to Different Planting Geometries in Maize–Soybean Relay Strip Intercropping Systems. *Agronomy Journal*, 107:296–304.