20 *Egypt. J. Hort.* **30**, No. 3-4, pp.291- 299 (2003)

Effect of the Interactions between Different Levels of Soil Moisture, Phosphorus and Iron on the Growth and Nutritional Status of Pepper Plants (*Capsicum annum* L.) Grown on a Calcareous Soil.

A.M. Eissa, S.R. Salman * and A.F.Abou-Hadid**

*Soils, Water & Environmental Res. Inst., ARC., * Veg. Res. Dept., National Research Centre,** and Horticultural Dep., Fac.Agric., Ain Shams Univ., Cairo, Egypt.*

A POT experiment was conducted during two successive seasons (2000 / 2001 and 2001 / 2002) to investigate the effect of interaction of different soil moisture, phosphorus and Iron levels on the fresh and dry weight production and nutritional status of pepper plants (*Capsicum annum* L.) grown on a calcareous soil. Obtained data revealed that there were significant differences between soil moisture levels on contents of N, P, K, Fe, Mn and Cu as well as uptake of P and Cu. Results showed that the highest dry weight was recorded in the highest soil moisture level when phosphorus and Iron were applied ($M_3P_2Fe_1$) while the lowest value was recorded in treatment ($M_1P_1Fe_2$). On the other hand, the highest contents for N, P and K were recorded in treatments ($M_2P_2Fe_1$) and ($M_3P_2Fe_0$), and ($M_1P_2Fe_0$), respectively while the lowest value for P was obtained in treatments ($M_1P_1Fe_0$), ($M_1P_1Fe_1$) and ($M_2P_1Fe_1$).

Soil moisture-nutrient interaction is one of the most important factors, which control the crop production. Cooke (1983) reported that there was still a serious lack in our research on water/nutrient interaction and it was no account of research, which established the nature, and magnitude of the full interaction between water and nutrients. Many investigations have shown that pepper plants are known to be sensitive to moisture stress at flowering and fruit setting stages (Berenyi, 1970; Dudnik, 1975 and Sandykov & Mekhael, 1981). Also, excess irrigation water may cause Fe chlorosis in plants grown on calcareous soils (Lindsay & Thorne, 1954). In contrast, summer drought may cause death of seedling that are susceptible to Fe chlorosis (Hutchinson, 1970). Hosner *et al.* (1965) and Abdel Rahman *et al.* (1971) concluded that water stress affects growth more than nutrient uptake, and the relative content of nutrients is higher for stressed plants, they added that increasing soil moisture from wilting percentage to saturation resulted in significant increases in the uptake of N, P, K and Ca by cotton and soybean plants. Also, Subrahmanyan & Mehta (1975); Teretak (1976); Rahmatullah *et al.* (1976) and Singa (1978) pointed out that the nutrient uptake in rye and wheat of N, P, Zn, Mg, Ca, Fe and Mn increased as the available soil moisture content increased. Therefore, the objectives of this experiment were to study the effect of interactions of different levels of soil moisture, phosphorus and iron on the fresh and dry matter production and nutritional status of pepper plants grown in calcareous soil.

Material and Methods

A surface soil sample (calcareous soil) was collected from (El-Banger region, El-Nubaria) near Alexandria for conducting this experiment. The soil was air dried, crushed, ground and sieved through 2mm sieve. The soil had a S.P of 50%; pH 8.34; EC 6.86 dS/m; CaCO3 27.78 % ;(soluble cations and anions) were 26.9 me/l of Ca, 6.6 me/l of Mg, 37.0 me/l of Na, 0.86 me/l of K,_33.0 me/l of Cl. Available nutrients in the soil sample were 0.2 ppm of P , 3.65 ppm of Fe, 2.47ppm of Mn, 0.73 ppm of Cu and 2.97 ppm of Zn. The chemical properties of the soil sample were determined according to the method described by Page (1982) and Westerman (1990). Available P, Fe, Mn, Zn and Cu were extracted from the soil sample using NH4CO3-DTPA (Soltanpour & Workman , 1979).

A pot experiment was carried out in the green house of Arid Land Agriculture Research Unit, Fac.Agric., Ain Shams University. A pot experiment was replicated for two successive seasons (2000/2001 and 2001/2002) to study the interactions of three levels of phosphorus of 50, 75 and 100 mg/kg soil (P_1, P_2 and P_3), three levels of iron 0, 2.5 and 5.0 mg/kg soil (Fe_0, Fe_1 and Fe_2) and three levels of moisture 70%, 100% and 125% of field capacity (M_1, M_2 and M_3) in the soil. The total numbers of treatments were 27 and each one was replicated 4 times. Black polyethylene bags were filled with 2kg of the studied soil sample. N at the rate of 100 mg/kg soil was applied uniformly in all the pots as KNO_3. P levels were applied as KH_2PO_4. Fe was applied as Fe-EDDHA. Seeds of sweet pepper (*Capsicum annum* L.) cv. Godeon F1 hybrid were sown on July 25th in nursery and one pepper seedling, was transplanted on 12 September 2000. Each pot had one seedling. Soil moisture was maintained daily according to the treatment. After 7 weeks from seedling, the vegetative growth was harvested just 1cm above the soil surface, then washed with tap and distilled water. The plants were oven dried at 70C, dry matter was recorded and samples were ground and kept in polyethylene bags for chemical analyses. Fe, Mn, Zn and Cu determination were carried out by using an atomic absorption spectrophotometer while P was determined colorimetrically by using ammonium molybdate and ascorbic acid (Watnabe & Olsen, 1965). N was determined by Kjhaldhel and K by flame photometer apparatuses.

Data of the two experiments were statistically analyzed according to the procedure outlined by Snedecor & Cochran (1980). Combined analysis was followed for the two experiments (2000/2001 and 2001/2002).

Results and discussion

*Interactions between different levels of soil moisture,*phosphorus and iron

Fresh weight of Shoots

Data in Table 1 show that the highest fresh weight of sweet pepper grown on the calcareous soil under investigation was obtained by application ($M_2P_3F_{e0}$) treatment, 18.25 gm/pot while the lowest one was obtained by application of both (M1P1Fe2) and (M2P1Fe2) treatments. It is clear that application of the heighest level of phosphorus (100ppm) with moisture content at 100 % of field capacity resulted in the highest fresh weight of sweet pepper while decreased the phosphorus to 50 ppm with 5 ppm of Fe as Fe-EDDHA reduced the fresh weight to the lowest value. These results are in agreement with Deniel *et al.* (1979) who reported that fresh and dry weights of leaves, stems, and roots for soybean gradually increased by increasing soil moisture content within the range from 25 to 100% of soil field capacity.

Dry weight of sweet pepper Shoot

Dry weight of one seedling sweet pepper shoot, under different interaction treatments between moisture content, phosphorus, and iron, ranged between 1.11and 2.29 gm/pot .The lowest value was obtained under the lowest moisture content and P-level under investigation while the highest one was obtained under the highest value of moisture content M3 and 75 of ppm P With 2.5 ppm of chelated iron. Similar results were obtained by Sojka *et al.*(1977) and Deniel *et al.* (1979) who reported that fresh and dry weights of leaves, stems, and roots for soybean considerably and gradually increased by increasing soil moisture content within the range from 25 to 100% of soil field capacity. Concerning the fresh and dry weigh there were not any significant differences between all treatments and the control treatment (M1P1Fe0).

N-content and uptake

Data in Table 1 indicate that N-content and its total uptake, in the shoot of sweet pepper under investigation were highly affected by the level of moisture, phosphorus and iron. It is clear that the highest N-content and /or total N –uptake were obtained under 100 %of moisture content of field capacity ,under different levels of phosphorus and iron .Moreover, increasing P-level from 50 to 75 or 100 ppm and Fe-level from 0 to 2.5 or 5.00 ppm led to increase ,mostly, N –content and its total-uptake by the shoot part of sweet pepper grown on the calcareous soil under investigation .These results indicate the balance between macro-and micro-nutrients as well as the moisture content results in more dry matter and nutrient uptake by sweet pepper under investigation .Similar results were obtained by Doss & Searsbrook (1969) who reported that N concentration in plant tissue is higher at hight moisture stress than at low values. Concerning the total N content, it was clear that there were highly significant differences between all treatments and the control treatment (M1P1Fe0). On the contrary, there weren't any significant differences for N uptake between all treatments.

TABLE 1. Effect of different levels of soil moisture,phosphorus and iron application on fresh,dry weight,content and uptake for N P K in pepper plant.

Treatment	Weight (gm/pot)		N		P		K	
	Fresh	Dry	Conc	Uptake	Conc	Uptake	Conc	Uptake
			%	mg/pot	%	mg/pot	%	mg/pot
M1 P1 Fe0	12.15	1.86	1.12	20.83	0.25	4.65	4.04	75.14
M2 P1 Fe0	11.66	1.32	1.28	16.90	0.32	4.22	4.44	58.61
M3 P1 Fe0	10.06	1.24	1.59	19.72	0.27	3.05	4.40	49.72
M1 P2 Fe0	10.83	1.37	2.14	29.32	0.26	3.22	4.74	64.91
M2 P2 Fe0	16.68	2.06	1.74	35.84	0.33	5.81	4.51	92.91
M3 P2 Fe0	15.69	1.97	1.32	26.00	0.49	9.50	4.19	82.54
M1 P3 Fe0	13.53	1.80	1.95	35.10	0.25	4.50	4.56	82.10
M2 P3 Fe0	18.25	2.16	2.09	45.14	0.33	7.13	4.45	96.12
M3 P3 Fe0	13.01	1.24	1.59	19.72	0.30	3.72	4.30	53.32
M1 P1 Fe1	10.20	1.27	1.85	23.50	0.25	3.18	3.94	50.04
M2 P1 Fe1	11.02	1.68	2.25	37.80	0.25	3.15	4.25	53.55
M3 P1 Fe1	11.59	1.48	1.65	24.42	0.26	3.22	3.69	45.76
M1 P2 Fe1	11.37	1.65	1.89	31.19	0.37	6.11	4.45	52.96
M2 P2 Fe1	10.82	1.38	2.39	32.98	0.38	5.24	3.70	51.06
M3 P2 Fe1	15.11	2.29	1.80	41.22	0.40	9.16	4.51	103.28
M1 P3 Fe1	11.62	1.59	1.79	27.99	0.28	4.33	4.35	65.03
M2 P3 Fe1	13.69	1.72	1.95	33.73	0.32	5.11	4.27	70.45
M3 P3 Fe1	13.09	1.64	1.59	26.22	0.34	5.73	4.22	66.92
M1 P1 Fe2	8.82	1.11	2.26	25.09	0.26	2.86	4.16	45.76
M2 P1 Fe2	8.68	1.21	2.08	25.17	0.27	2.94	3.92	42.73
M3 P1 Fe2	12.09	1.38	1.60	22.08	0.31	5.02	4.37	60.31
M1 P2 Fe2	11.22	1.52	1.86	27.57	0.27	4.12	4.32	62.28
M2 P2 Fe2	12.97	1.65	1.97	32.51	0.31	4.80	4.22	66.49
M3 P2 Fe2	12.95	1.61	1.59	25.63	0.34	5.63	4.24	65.98
M1 P3 Fe2	15.00	1.89	2.17	41.01	0.30	5.67	4.34	82.03
M2 P3 Fe2	9.80	1.32	1.66	21.91	0.35	4.62	4.62	60.98
M3 P3 Fe2	10.78	1.47	1.61	23.67	0.37	5.44	4.41	64.83
L.S.D at 5%	**N.S.**	**N.S.**	**0.12**	**N.S.**	**0.03**	**1.18**	**0.19**	**N.S.**
L.S.D at 1%			0.15		0.04	1.41	0.23	

P-content and uptake

Data obtained in Table 1 show that P-content in the sweet pepper shoot was slightly affected under the different P-levels under investigation .It was ranged between 0.25%and or 0.40 %. The lowest value was obtained under low level of moisture content (70%of field capacity) as well as75 ppm of phosphorus and 2 ppm of Fe- chelated compound. The same trend was obtained for the total-P uptake. Concerning the total P content and uptake, it was clear that there were highly significant differences between all treatments and the control treatment (M1P1Fe0).

K-content and uptake

Data in Table 1 indicate that K-content in the shoot part of sweet pepper was slightly changed under different moisture, phosphorus and iron treatments under investigation. K-content ranged between 3.69% and 4.74% .The highest K-content value was obtained under the lowest moisture and 75 ppm of P., however, the lowest K-content was obtained under the highest moisture content with 50 ppm of P. On the other hand, the lowest and highest total K-uptake was corresponding to the lowest and highest dry matter content of the shoot part of sweet pepper under investigation.

The above mentioned results for P and K concentrations are in agreement with those obtained by Marais & Wiersma, (1975) and Oliver & Barber (1966) who reported that low soil water content reduces P and K uptake by plant roots because P and K diffusion rates decreases as soil water content decreases. Soil water content, however, has a variable effect on P and K tissue concentrations because their concentrations are affected by both rates of uptake and plant growth.

Fe-content and uptake

Data in Table 2 indicate that Fe-content and its total uptake, in the shoot of sweet pepper under investigation, were highly affected by the level of soil moisture, phosphorus and iron. It is clear that the highest Fe-content and /or total Fe-uptake were obtained under 100% of soil moisture content of field capacity, under the different levels of phosphorus and iron. Fe-content ranged between 208.81 and 554.50 ppm. The highest value was obtained under treatment ($M_2P_1Fe_1$), while the lowest value was obtained under treatment ($M_3P_1Fe_2$). On the contrary, the highest Fe-uptake was recorded in treatment ($M_2P_2Fe_0$) while the lowest Fe-uptake was recorded under treatment ($M_3P_1Fe_1$). These results indicate that raising soil moisture to 125% of field capacity decreased Fe-content and Fe-uptake. These results are in agreement with those obtained by Inskeep & Bloom (1984) who found that excess P is known to affect the translocation and solubility of Fe within plants and it is probably one factor contributing to Fe deficiency under field conditions. The Fe uptake did not differ significantly between the treatments while the Fe content gave highly significant differences between the treatments and control (M1P1Fe0).

TABLE 2. Effect of different levels of soil moisture, phosphorus and iron application on cc content and uptake for Fe, M, Zn and Cu in pepper plant.

Treatment	Fe		Mn		Zn		Cu	
	Conc %	Uptake mg/pot	Conc ppm	Uptake mg/pot	Conc ppm	Uptake ug/pot	Conc ppm	Uptake ug/pot
M1 P1 Fe0	273.79	0.52	100.82	0.19	35.50	66.03	56.75	110.00
M2 P1 Fe0	353.44	0.47	153.34	0 20	40.43	53.37	53.17	70.00
M3 P1 Fe0	239.88	0.30	121 19	0.14	41.81	47 25	76 42	90.00
M1 P2 Fe0	366.44	0.50	137.58	0.17	44.50	55.13	38.58	50.00
M2 P2 Fe0	380.75	0.78	116.75	0.21	47.25	83.16	45.38	90.00
M3 P2 Fe0	214.00	0.42	95.62	0.19	32.56	64.14	67.25	130.00
M1 P3 Fe0	349.75	0 63	130 81	0.24	35.67	64.21	24.33	40.00
M1 P3 Fe0	314.94	0.38	81.06	0.18	64.43	139.17	68.00	150.00
M2 P3 Fe0	247 94	0.31	111.50	0.14	36.00	44.64	57.33	70.00
M1 P1 Fe1	342.94	0.44	92.33	0.12	35.67	45 30	40.75	50.00
M2 P1 Fe1	554.50	0.70	74.50	0.09	45.42	57 23	53 63	90.00
M3 P1 Fe1	226.50	0 23	73.44	0.10	52.50	65.10	52.33	30.00
M1 P2 Fe1	274.33	0.33	78.75	0.09	44.00	62 36	52.67	100.00
M2 P2 Fe1	417.00	0 58	39 42	0.12	48.67	67 16	70.13	100.00
M3 P2 Fe1	329.69	0 60	76.88	0.14	61.33	112.23	67.67	150.00
M1 P3 Fe1	322.46	0 48	108.17	0 16	39 07	56.62	43.32	70 00
M2 P3 Fe1	404 13	0.58	103.01	0.16	49.24	80 02	56.06	100.00
M3 P3 Fe1	251.60	0.38	96.73	0.14	44.34	66.67	64.31	104.00
M1 P1 Fe2	313.25	0 35	93.00	0.11	44.25	48.63	38.94	40 00
M2 P1 Fe2	269.63	0.29	94 50	0.10	57.25	62 40	42.50	50 00
M3 P1 Fe2	208.31	0 34	94.69	0.15	46.58	75.46	75.69	100 00
M1 P2 Fe2	321.36	0 46	106.72	0 15	39.81	55 48	43.26	65.71
M2 P2 Fe2	384.91	0.54	101.80	0.15	50.38	77 50	55.34	92 86
M3 P2 Fe2	245.49	0.36	96.44	0.14	45.09	67.93	65.94	103.43
M1 P3 Fe2	300.31	0.57	104.00	0.20	39.69	75.01	60.25	110.00
M2 P3 Fe2	305 33	0.40	83.08	0.11	43.17	56 96	64.58	90.00
M3 P3 Fe2	271.69	0.40	51.42	0.08	34.33	50.47	45.83	70.00
L.S.D at 5%	**56.69**	**N.S.**	13.13	**N.S.**	**N.S.**	**N.S.**	7.23	**16.45**
L.S.D at 1%	67.71		15.68	-			3.63	19.65

Mn-content and uptake

Data in Table 2 indicate that Mn-content in the shoot part of sweet pepper was changed under investigation. Mn-content was ranged between 51.42 and 153.34-ppm .The highest value was recorded under treatment ($M_2P_1Fe_0$). The lowest values for both Mn-content and uptake were recorded under treatment ($M_3P_3Fe_2$) while the highest ones were recorded under treatment ($M_1P_3Fe_0$). Generally, increasing Fe application from Fe_0 to Fe_1 and from Fe_0 to Fe_2 with various soil P-applications (P_1, P_2 and P_3) decreased Mn uptake at the three levels of soil moisture except that treatment ($M_3P_1Fe_2$). These results confirm with those obtained by Verma & Minhas (1989) who found that application of Fe decreased the concentration and uptake of Mn on paddy yield.

Zn-Content and uptake

Data obtained in Table 2 show that Zn-content in shoot of the sweet pepper under the investigation was affected. Zn-content ranged between 32.56 and 64.43 ppm. The lowest value was recorded under treatment ($M_3P_2Fe_0$) while the highest Zn-content and uptake were recorded under treatment ($M_3P_2Fe_0$). The lowest value for Zn uptake was recorded in treatment ($M_3P_3Fe_0$). These results indicate the antagonistic effect of high levels of either phosphorus or iron on Zn uptake. Similar results were obtained by Ismail *et al.* (1995) who found that, under greenhouse experiment, P application caused a progressive decrease on Zn concentration and uptake by tomato plant.

Cu-content and uptake

Data in Table 2 show that Cu-content was affected under the different levels of soil moisture, P-levels and Fe application. Cu-content ranged between 24.33 and 76.42 ppm. The highest value was recorded under treatment ($M_3P_1Fe_0$) while the lowest value was obtained under treatment ($M_1P_3Fe_0$). The lowest Cu-content and uptake were recorded under treatment ($M_1P_3Fe_0$), whilst the highest value for Cu-uptake was recorded in treatment ($M_3P_2Fe_1$).

The analysis for mineral content (Mn and Cu) indicated that there were highly significant differences between the treatments and there were no significant differences between the treatments for Zn content and uptake for Mn and Zn .While there was a significant difference for Cu uptake between the treatments.

In conclusion, the soil water status in the root zone had an effective role on nutrients content and uptake, and it was considered as one of the limiting factors for crop production.

References

Abdel-Rahman, A.A., Shalaby, A.F. and El-Monayeri, M.L. (1971) Effect of moisture stress on metabolic products and ions accumulation. *Plant and Soil*, (34), 65.

Berenyi, M. (1970) Effect of irrigation on flowering and fruiting set of red pepper, *Acta.Agron.Hung.* (19), 398.

Cooke, G.W. (1983) Colloquium of the (P) (*Potash Review*. Subject 6.48th Suite.No.7). (c.f. ....

Deniel, C., Walter, E. and Splittstossr, A. (1979) The effects of water regimes on leaf water potential, growth, and development of soybeans. *Physiol.Plant.* **38**, 131

Doss, B.D. and Searsbrook,C.E. (1969) Effect of irrigation on recovery of applied nitrogen by cotton. *Agron. J.* **61**, 37.

Nudnik, S.P. (1975) The effect of soil water supply capsicum grown on the left bank of the Ukrainian forest steppe. *Ovochivnitstovol. Bashtannitstva. Resp. Mizhvidtemat. Nauk Zbornik.* **20,12.**

Hosner, J.R., Leaf, A.L., Dickson, R. and Hart, Jr. J.B. (1965) Effects of varying soil moisture upon the nutrient uptake of four bottomland tree species. *Soil Sci. Soc. Am. Proc.* **29**, 313.

Hutchinson, T.C. (1970) Lime chlorosis as a factor in seedling establishment on calcareous soils. *New.Phytol.* **69**, 143.

Inskeep, W.P. and Bloom, P.R. (1984) A Comparative study of soil solution chemistry associated with chlorotic and nonchlorotic soybeans in western *Minnesota. J. Plant Nutr.* 7. 513.

Ismail, A.S., Orabi, A.A. and Mostafa, M.A. (1985) Iron–phosphorus relationship in nutrition of tomato seedlings grown on an alluvial and calcareous soils. *Plant and Soil*, **83**, 323.

Lindsay,W.L. and Thorne, D.W. (1954) Bicarbonate ion and oxygen level as related to chlorosis. *Soil.Sci.* **77**, 71.

Marais, J.N. and Wiersma, D. (1975). Phosphorus uptake by soybeans as influenced by moisture stress in the fertilizer zone. *Agron. J.* **67**, 777.

Oliver, S.R. and Barber, S.A. (1966) An evaluation of the mechanisms governing the supply of Ca, Mg, K.and Na to roots (Glycine max). *Soil. Sci. Soc. Am.Proc.* **30**, 82.

Page,A.L. (1982) *Methods of Soil Analysis.* Part 2. *Chemical and Microbiological Properties.*

Rahmatullah, F., Chaudhru, M. and Rashid, A. (1976) Micronutrient availability to cereals from calcareous soils 2-Effect of flooding on electro chemical properties of soil. *Plant and Soil*, **45**, 411.

Sandykov, I.M. and Mekhael, ZH.YU. (1981). Irrigation regime in direct –sown capsicums. *Trudy kuban.S.Kh.In.T.*, 197-225, 114-118.

Singa, D.P. (1978) Relation of soil moisture and air conditioning irrigation to plant water balance, growth characteristics and nutrients uptake in rye and wheat. *Biol. Plant.* **20**, 161.

Snedecor, G.W. and Cochran, W.G. (1980) *Statistical Methods.* 5th ed. Iowa State Univ. Press, Iowa , USA.

Sojka, R.E., Scott, H.D., Fergusson, J.A. and Ruttedge, F.M. (1977) Relation of plant water status to soybean growth. *Soil Sci.* **123**, 182.

Soltanpour, P.N. and Workman, S. (1979). Modification of the NH4-HCO3-DTPA soil test. *Soil Sci.and plant.Anal.* **10**, 141.

Subrahmanyan, and Mehta, B.V. (1975) Effect of Zn,Fe,and moisture on the availability of Zn, Fe, Mn in *soil. J. Ind. Soil Sci.* **23**, 236.

Terelak, T. (1976) The content and distribution of available forms of iron and aluminum in the soil profile in relations to pH and moisture content. *Pamietnik Pulauski*, 55.

Verma, T.S. and Minhas, R.S. (1989) Effect of iron and manganese interaction on paddy yield and iron and manganese nutrition in silicon –treated and untreated.*Soil Science*,**147**, 2.

Watanabe, F.S., Olsen, S.R. (1965) Test of ascorbic acid method for determining phosphorus in water and NaHCO3 from soil. *Soil Sci. Soc.Am. Proc.* **29**, 277.

Westerman, R.L. (Ed.) (1990) *Soil Testing and Plant Analysis*, 3rd ed.Soil Science Society of America, Inc. Madison, Wisconsin, USA.

(*Received* 3 /12 /2003)

اثر التفاعلات للمستويات المختلفة للرطوبة الارضية و الفوسفور والحديد علىالنمو والحالة الغذائية لنباتات الفلفل المزروع فى ارض جيرية

احمد محمود عيسى ، سميررجب سالمان* وايمن فريد ابو حديد**

*معهد بحوث الاراضى والمياة والبيئة – مركز البحوث الزراعية ، *قسم البساتين – المركز القومى للبحوث و **قسم البساتين– كلية الزراعة – جامعة عين شمس – القاهرة – مصر .

اجريت تجربتان تحت ظروف الصوب لموسمى ٢٠٠١ و٢٠٠٢ لدراسة اثر الاضافات المختلفة لعنصرى الفوسفور والحديد تحت ثلاثة مستويات من الرطوبة الارضية على انتاج المادة الخضراء والجافة لنبات الفلفل المزروع فى ارض جيرية وتركيز وامتصاص بعض العناصر. ولقد اوضحت النتائج وجود اختلافات معنوية مع أختلاف مستويات الرطوبة الارضية على تركيز النتروجين والفوسفور وكذلك على امتصاص الحديد والمنجنيز والنحاس. أيضا أوضحت النتائج ان اعلى وزن مادة جافة لنبات الفلفل قد سجلت تحت ظروف اعلى مستوى للرطوبة الارضية عند١٢٥% من السعة الحقلية مع تركيز للفوسفور المضاف ٧٥ جزء فى المليون وتركيز للحديد المخلبى المضاف ٢,٥ جزء فى المليون . بينما سجلت اقل قيمة للوزن الجاف لنباتات الفلفل عند مستوى رطوبة أرضية ٧٠ % من السعة الحقلية مع تركيز للفوسفور المضاف٥٠ جزء فى المليون مع تركيز للحديدالمخلبى المضاف ٥ جزء فى المليون. كذلك اوضحت النتائج ان اعلى تركيزللنتروجين سجل تحت مستوى رطوبة ارضية ١٠٠% من السعة الحقلية ومستوى تركيز للفوسفور المضاف ٧٥ جزء فى المليون مع تركيز للحديد المخلبى المضاف ٢,٥ جزء فى المليون . وقد سجلت النتائج اعلى قيمة لتركيز الفوسفور تحت مستوى رطوبة أرضية ١٢٥% من السعة الحقلية ومستوى تركيز للفوسفور المضاف ٧٥ جزء فى المليون مع الاكتفاء بتركيز الحديد الموجود اصلا بالتربة . وقد سجلت النتائج ان اعلى قيمة لتركيز البوتاسيوم فى النباتات النامية عند مستوى رطوبة ارضية ٧٠% من السعة الحقلية مع مستوى تركيز للفوسفور المضاف ٧٥% جزء فى المليون مع الاكتفاء بتركيز الحديد الموجود اصلا بالتربة.