WATER REQUIREMENT, DEFICIT IRRIGATION AND CROP COEFFICIENT OF HOT PEPPER (*Capsicum frutescens var legon18*) USING IRRIGATION INTERVAL OF TWO (2) DAYS

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ABSTRACT

This paper reports on the first part of a study whose objective was to calibrate and evaluate the FAO crop model AquaCrop for hot pepper. Specifically, it reports on the water requirement of hot pepper using an irrigation interval of two (2) days and also the effect of deficit irrigation on the growth and yield of hot pepper. At 100% water application (full irrigation), the crop coefficients for hot pepper were determined to be in the ranges: 0.41 - 0.74, 0.72 - 0.83, 0.98 - 1.03 and 0.5 - 0.74 for the initial, developmental, mid-season and late season stages, respectively. The total amount of water applied for the 118 days ranged between 320mm and 432mm. The water use pattern had a significant effect on the yield and agronomic parameters of the crop such as plant height and leaf area. 20% deficit irrigation had no significant reduction on the yield of hot pepper but above this threshold there was an adverse effect on the growth and yield.

Keywords: hot pepper, crop water requirements, deficit irrigation, yield.

INTRODUCTION

The ever changing climatic conditions and the need to meet the food demand of the ever growing human population are causing major problem in agriculture, especially, in developing countries. FAO (2003) indicated that about 800 million people, mostly in Africa, sleep daily without food. The solution is simply to increase crop production to meet the intimidating demands. Indications are that the rainfall pattern is changing, becoming more unpredictable. Even in areas where total seasonal rainfall is adequate on the average, it may be poorly distributed during the year and variable from year to year.

Water stress in pepper leads to the destruction of plant organs sensitive to lack of moisture. These organs include flowers, apical meristems and bud (Huguez and Philippe, 1998). Some periods in the growth of a plant namely germination and emergence, flowering and fruit set have been identified by Norman (1992) as the periods, most critical to water stress conditions, resulting in tissue wilting and death of whole plants. The inability of rainfall to compensate for evapotranspiration losses by a crop necessitates the application of irrigation if better yield and growth is to be obtained by the farmer. Deficit irrigation is a strategy that allows a crop to sustain some degree of water deficit in order to reduce costs and potentially increase income. It may lead to increased net income where water costs are high or where water supplies are limited. This paper reports on the first part of a study whose objective was to calibrate and evaluate the FAO crop model AquaCrop for hot pepper. Specifically, this paper reports on the effect of deficit irrigation on the growth and yield of hot pepper. The second paper is dedicated to the calibration and validation of AquaCrop for full and deficit irrigation of hot pepper.

MATERIALS AND METHODS

Study area

The study area was the School of Agriculture Teaching and Research Farm at the University of Cape Coast, Ghana. It lies on latitude 5°06'N and longitude 1°15'W at an altitude of 1.1m. The soil is described as sandy loam with characteristics as neutral to slightly acidic in reaction and with a pH of 6.5. This site lies within the coastal savannah vegetation zone of Ghana. The soil is described as sandy loam with characteristics as neutral to slightly acidic in reaction and with a pH of 6.5. According to Owusu-Sekyere *et al*. (2010), the annual temperature is 23.2-33.2ºC with an annual mean of 27.6ºC and a relative humidity of 81.3-84.4%. The study area experiences two rainy seasons, namely the major season which starts from May and ends in July and a minor season that starts around September and ends around mid- November to give way to the dry Harmattan season that runs till the end of March in the subsequent year.

Experimental design and cultivation practices

In all, two field experiments were conducted. The first one involved the growing of hot pepper in plastic buckets filled with sandy loam soil using an irrigation interval of two days. The results obtained were used to calibrate the AquaCrop model and this was done between November, 2010 and March, 2011. The second experiment, similar to the first one, provided results used in validating the AquaCrop model and this was carried out between January, 2011 and May, 2011.

The Randomized Complete Block Design (RCBD) was used, with four irrigation treatments (T_1, T_2, T_3, T_4) and three replications (R_1, R_2, R_3). There were 5 plants per treatment under each replication with plant spacing of 1.0 m. The experiments were carried out under a rain shelter.

Water treatments

The treatments were as follows:

T_1 = 100% ETc
T_2 = 90% ETc
T_3 = 80% ETc
T_4 = 70% ETc

Planting

Seeds of Legon 18 variety of hot pepper were nursed on a seed bed about 25cm deep in rows 10-15cm apart and transplanted after 21 days for each of the experiments. A week before transplanting, water supply at the nursery was reduced in order to harden the seedlings to reduce transplanting shock. Prior to transplanting, the nursery was watered until near to soil saturation to enhance easy uprooting of seedlings and to prevent damage to roots of the seedlings. Transplanting was done two days after saturation. Each bucket had one seedling.

Cultivation practices

Weeds were removed by hand as soon as they appeared and spraying was done once during each experimental period and it was done one week before the flowering stage.

Growth stages

In all, four growth stages were considered, namely: the initial stage (excluding seedlings at the nursery), the development stage (period of rapid growth of the crop, also known as vegetative stage), the mid-season stage (flowering and fruiting stage), and the late season stage (full maturity and ripening of fruits).

In both experiments, the initial stage lasted for 16 days, the developmental stage lasted for 30 days, the mid-season stage lasted for 50 days whilst the late season stage lasted for 22 days. This stage was later characterized by senescence and drying of leaves after the harvesting was over.

Irrigation regime

A two-day irrigation interval was adopted and the volume of water to be applied on each two-day interval was derived from the computed loss in weight of each set up over the last two-days. The equivalent in volume basis was found and applied to the plants as the various treatments demanded. Irrigation days for both experiments amounted to 59 days out of the 118 days of the growing period.

Soil analysis

Soil samples were taken from each bucket and were thoroughly mixed together. The samples were divided into four and two opposite quadrants were taken out. This was repeated and each time, another opposite quadrant was taken off until a substantial amount was obtained. The sample was then dried for four days after which it was ground and then analyzed for the amount of nitrogen, phosphorous and potassium. Soil at two growth stages (initial and late seasons) were considered for analysis.

Calculation of crop water requirement (ETc) and crop co-efficient (Kc)

Crop water requirement and crop coefficient were determined as follows:

a) $\mathbf{ET_c} = \mathbf{ET_O} \times K_c$

b) $\mathbf{K_c} = \dfrac{\mathbf{ET_c}}{\mathbf{ET_O}}$

c) $\mathbf{ET_O}$ = Epan × Kpan

d) $\mathbf{ET_c}$ (2days) = Loss in weight of buckets.

e) $\mathbf{ET_c}$ for a growth stage = Summation of $\mathbf{ET_c}$ for the number of irrigation days

Where

$\mathbf{ET_c}$ = Crop evapotranspiration or Crop water requirement (mm/day)
$\mathbf{K_C}$ = Crop factor
$\mathbf{ET_O}$ = Reference evapotranspiration (mm/day)
Kpan= Pan co-efficient (0.80)

f) Epan = Pan Evapotranspiration (mm/day)

Plant growth parameters measured

Plant height

Plant height at the initial, developmental, mid-stage and the late-season stages were measured using a meter rule. All five plants for each treatment per replication were selected and their heights at the various growth stages were measured at specific intervals after transplanting. The data obtained were summed up and their mean heights were obtained by dividing the sum by the number of plants selected.

Leaf area

Five leaves from different parts of the plants were selected on each of the plants. The longest part along the petiole line of the leaf and the widest breadth across the leaf were measured as the length and width of the leaf by using a meter rule. The product was multiplied by a factor of 0.75 to get the leaf area (Squire, 1990).

Mean number of fruit per treatment

The number of fruits per treatment was determined by counting the number of harvested fruits on each of the plants on each treatment. The numbers obtained were then summed up and divided by fifteen.

Mean fruit weight

The number of fruits produced by each of the plants under each treatment was weighed using an electronic analytical balance. These were then summed up and divided by the number of plants.

Reference evapotranspiration rate and rainfall reading

Evaporation rate and amount of rainfall readings were obtained from a US Class A evaporation pan and a rain gauge, respectively situated at the farm where the experiments were conducted. There were two rainfall events during the first experimental period whereas the second experimental period recorded five rainfall events. Daily reduction in the water level in the pan with reference to the initial level was noted. Each of these readings was accumulated for each of the growth stages and was multiplied by the pan factor (0.8) to obtain the reference evapotranspiration (ETo). The pan factor of 0.8 was chosen because it was placed in an area which has a moderate wind speed of 2-3ms^{-1} and a high humidity.

Statistical analysis

All data collected were subjected to analysis of variance and the differences between means were determined using least significant difference at the probability level of 5%.

RESULTS AND DISCUSSIONS

At the end of both experiments, 319.5 mm and 432.05 mm were recorded as the water requirement for the 118 days growing period after transplanting while the Crop co-efficients (Kc) were 0.74, 0.83, 1.03 and 0.5 for the initial, developmental, mid-season and the late season stages respectively for the first experiment (Table-1), and 0.41, 0.72, 0.98 and 0.74, respectively for the second experiment (Table-2).

These values are quite different from the FAO mean crop coefficients for hot pepper (FAO, 1999). The water requirement was 600mm for the growing period of 120 days. The crop coefficient (Kc) was 0.4 following transplanting, 1.1 during full cover and 0.9 at time of harvest. The differences in Kc values could be due to the shorter growth periods used in this work. Owusu-Sekyere *et al.* (2010) also recorded Kc values of 0.47, 0.86, 1.42 and 0.91 for the initial, developmental, mid-season and the late season stage, respectively for hot pepper. These values compare quite well with those obtained in this work. The differences might again be due to differences in growth periods used.

Table-1. Growth period, ETo, ETc and Kc for all the growth stages for experiment-1.

Growth stage	**Period** (days)	**ETo**	**ETc** (100 %)	**ETc** (90 %)	**ETc** (80 %)	**ETc** (70 %)	**Kc** (100 %)	**Kc** (90 %)	**Kc** (80 %)	**Kc** (70 %)
Initial	16	40.8	30.0	25.7	21.9	19.1	0.74	0.63	0.53	0.47
Dev.	30	105.6	87.5	78.5	69.0	59.5	0.83	0.74	0.65	0.56
Mid.	50	169.6	174.5	152.5	140.0	131.5	1.03	1.90	1.83	1.77
Late	22	55.2	27.5	24.0	21.0	18.0	0.5	0.43	0.38	0.33
Sum			319.5	280.7	251.9	228.1				

Table-2. Growth period, ETo, ETc and Kc for all the growth stages for experiment-2.

Growth stage	**Period** (days)	**ETo**	**ETc** (100 %)	**ETc** (90 %)	**ETc** (80 %)	**ETc** (70 %)	**Kc** (100 %)	**Kc** (90 %)	**Kc** (80 %)	**Kc** (70 %)
Initial	16	60.10	25.0	20.2	15.7	12.3	0.41	0.34	0.26	0.20
Dev.	30	134.6	96.0	80.4	75.5	63.6	0.72	0.60	0.56	0.47
Mid.	50	240.0	235.0	190.7	155.8	133.1	0.98	0.80	0.65	0.55
Late	22	102.55	75.55	45.6	35.0	29.0	0.74	0.40	0.34	0.28
Sum			432.05	336.9	282.0	238.0				

The lower Kc value obtained at the initial stage also confirms the assertion made by Allen *et al.* (1998) that crop coefficients are low in the early season due to small leaf area and hence low water uptake and this approaches unity as the canopy reaches maximum development with corresponding increase in water use by the crop. Doorenbos and Pruitt (1979) also noted that plant height and total growing season influence crop coefficient values. The higher the plant height and the longer the growing season, the higher the crop coefficient values and vice versa. According to Pereira (1998), environmental factors such as temperature, solar radiation, wind speed and relative humidity prevailing at the experimental site has influence on the crop water need of a plant. These could be the reason for the slight difference between crop coefficient values recorded by various researchers as well as in this work. Also, Agodzo *et al.* (2003) indicated that the crop water requirements ranged between 300-700mm depending on the climatic condition and the season of the crop and the location. Grimes and Williams (1990) also asserted that water requirement for hot pepper per growing season ranges between 400-500mm depending on the season of planting and the climatic conditions prevailing in the area. The findings in this work are in agreement

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with the findings of Agodzo *et al*. (2003) and Grimes and Williams (1990) and can be concluded that the water requirement of hot pepper for the Cape Coast area ranges between 320 - 432mm.

From Table-3, it can be observed that in both experiments T_1 at the various stages of the crop development produced the highest mean plant height.

Table-3. Mean plant height (cm) for the treatments at the various stages of plant growth for both experiments.

Treatment	First experiment				Second experiment			
	Initial 14 DAT	Developmental 42 DAT	Mid-season 91 DAT	Late season 118 DAT	Initial 14 DAT	Developmental 42 DAT	Mid-season 91 DAT	Late season 118 DAT
T_1	21.40a	34.67a	41.53a	50.7a	21.07a	37.07a	39.83a	49.27a
T_2	16.73b	30.60b	36.67b	45.6a	16.07b	36.13a	39.33a	45.20ab
T_3	16.53b	28.60bc	35.80b	45.3a	15.93b	32.73b	37.53a	44.60b
T_4	15.00c	27.00c	34.73b	43.5b	14.67c	29.93b	34.13	39.93c
	Prob.= 0.05 Sed = 0.673 Lsd = 1.348	Prob.= 0.05 Sed = 1.246 Lsd = 2.496	Prob.= 0.05 Sed = 1.724 Lsd = 3.454	Prob.= 0.05 Sed = 2.93 Lsd = 5.86	Prob.= 0.05 Sed = 0.606 Lsd = 1.214	Prob.= 0.05 Sed = 1.484 Lsd = 2.972	Prob.= 0.05 Sed = 1.385 Lsd = 2.774	Prob.= 0.05 Sed = 2.301 Lsd = 4.610

Mean plant heights within a column with the same letter are not significantly different from each other at 5% probability level

In the first experiment, for all the growth stages of the crop development, the plant heights for T_2 and T_3 were not significantly different from each other. At 118DAT, T_1, T_2 and T_3 recorded mean plant heights that were not significantly different from each other. T_1 maintained the highest height of 50.7cm followed by T_2 with mean value of 45.6cm and by T_3 with mean value 45.3cm. T_4 recorded the lowest mean plant height of 43.5cm which was significantly different from the other treatments.

In the second experiment, for all the growth stages of the crop development with exception of the developmental stage, the plant heights for T_2 and T_3 were not significantly different from each other as was observed in the first experiment. At 42 DAT, T_1 and T_2 were significantly different from T_3 and T_4. At 91 DAT, T_1, T_2 and T_3 recorded mean plant heights that were not significantly different from each other. T_1 maintained the highest height of 39.83cm followed by T_2 with mean value of 39.33cm and by T_3 of mean value 37.53cm. T_4 recorded the lowest mean plant height of 34.13cm which was significantly different from the other treatments.

Water is very essential for plant growth. Plants may grow by cell expansion after the cell goes through division to increase the number and size of cell. Cells grow by taking up water. However, T_1 had the greatest mean height for all the growth stages followed by T_2, T_3 and T_4 in both experiments. The irrigation water applied was used to the advantage of the plants that were fully irrigated. This is in agreement with Allen *et al*. (1998) that plants grow rapidly with increase in crop water use. Also as water used by plants is optimum, growth is rapid since the plants will have enough water to be transpired by leaves to increase leaf area, plant height and root development.

Available water, when less than the crop water requirement would make the plant reduce its rate of metabolic activities such as photosynthesis (Kramer, 1983), root respiration (Wilcox, 1987), transpiration and translocation (Craft, 1999) which are some of the important plant metabolic activities. The works of Berrie and Berrie (1990) and Norman (1995) indicate that if the availability of soil moisture becomes a limiting factor then the extent of transpiration of the plant should be expected to decrease as the physiological mechanism to sustain the plant and subsequently the rate of growth and development will decrease further support this work. This is evidenced by plants which received 70% of the irrigation water applied as they recorded the lowest mean plant height for all the growth stages.

From Table-4, analysis of variance of the various treatment means at 5% probability level showed that significant difference existed among the treatments at the various growth stages. However T_1 produced the largest mean leaf area of 47.5cm^2 and 47.3cm^2, respectively at 91 DAT for both experiments while T_4 produced the lowest mean leaf area of 36.9cm^2 and 36.7cm^2 for experiments 1 and 2, respectively. At the late season stage of crop development, very low mean leaf areas were recorded for the various treatments with the treatments being significantly different from each other.

T_1 produced the highest mean leaf area for the three stages of growth and was significantly different from T_3 and T_4. The results for the developmental stage to mid-season stage for all treatments are in agreement with the work of Powler (1984) who observed that leaf area increased with water application. Relative water content in leaves is considered an alternative measure of plant water status reflecting the metabolic activity in plant tissues (Flower and Ludlow, 1986). Treatments T_2, T_3 and T_4

showed that water stress decreases leaf area relative to water content leading to reduced leaf area compared to T_1.

Table-4. Mean leaf area (cm^2) for the treatments at the 3 growth stages of plant growth for both experiments.

Treatment	First experiment			Second experiment		
	Developmental 42 DAT	**Mid-season 91 DAT**	**Late Season 133 DAT**	**Developmental 42 DAT**	**Mid-season 91 DAT**	**Late Season 133 DAT**
T_1	42.84a	47.5a	8.64a	42.61a	47.3a	8.88a
T_2	39.28ab	44.8ab	5.82b	39.73ab	44.0ab	5.83b
T_3	35.49bc	38.8bc	4.12c	35.99bc	38.2bc	4.28b
T_4	31.86c	36.9c	2.16d	31.74c	36.7c	2.45c
	Prob.= 0.05 Sed.= 2.651 Lsd = 5.311	Prob.= 0.05 Sed.= 3.68 Lsd =7.37	Prob.= 0.05 Sed.= 0.812 Lsd =1.628	Prob.= 0.05 Sed.= 2.60 Lsd = 5.390	Prob.= 0.05 Sed.= 3.57 Lsd =7.16	Prob.= 0.05 Sed.= 0.791 Lsd =1.585

Mean leaf areas within a column with the same letter are not significantly different from each other at 5% probability level

The low values of leaf area recorded during the late season stage are not unexpected. These values were recorded 15 days after irrigation was ceased for all treatments. The low values could be attributed to the drying up and wilting of leaves at this stage. Again this decrease could be attributed to root systems which are not able to compensate for water lost by transpiration through a reduction of the absorbing surface (Leung, 2001). This reduction in leaf growth is associated with a reduction in photosynthetic capacity as a result of no water application and stage of the pepper plant. This suggests that deficit irrigation has significant effect on pepper leaf area and therefore confirms the assertion made by Kozlowski (1964) that moisture stress reduces plant leaf area by restricting cell expansion in the leaf.

From Table-5, there was no significant difference noted for T_1, T_2 and T_3 in the first experiment. However T_1 in the second experiment produced mean number of fruits that was significantly different from T_2, T_3 and T_4. In the first experiment T_1 produced the highest mean number of 19.1 fruits, closely followed by T_2 producing 19.0 fruits against 15.87 for T_1 and 9.20 for T_2 in the second experiment. T_3 also recorded 13.7 fruits for experiment 1 against 7.00 in the second experiment. T_4 which was significantly different from T_1 recorded the lowest mean number of fruits as 11.3 and 4.8, respectively in experiments 1 and 2.

Table-5. Yield component for the treatments for both experiments.

Treatment	First experiment			Second experiment		
	Mean number of fruits per treatment	**Mean fruit weight** (g)	**Mean yield** (tons/ha)	**Mean number of fruits per treatment**	**Mean fruit weight** (g)	**Mean yield** (tons/ha)
T_1	19.1a	48.9a	2.44	15.87a	32.7a	1.63
T_2	19.0a	39.9ab	1.99	9.20b	19.2b	0.96
T_3	13.7ab	33.8bc	1.69	7.00b	12.4bc	0.62
T_4	11.3b	25.4c	1.27	4.80b	4.9c	0.24
	Prob = 0.05 Sed. = 2.7 Lsd = 5.5	Prob = 0.05 Sed.= 6.04 Lsd = 12.1		Prob = 0.05 Sed.= 2.320 Lsd = 4. 647	Prob = 0.05 Sed.= 4.58 Lsd = 9.18	

Treatment means followed by the same letter are not significantly different at 5% probability level but means with different letters are significantly different from the rest

The data show a direct relationship between water applied and the mean number of fruits per treatment and correspond with Pellitero *et al*. (1993) who showed that the number of fruits per treatment decreased as soil water deficit increased. It is also in line with earlier works by Pill and Lambeth (1980) who observed a reduction in the fruit number with decreasing soil water, explaining that the lower soil moisture could result in pollen and stigma dehydration as well as unnecessary elongation of flower style which could result in up to 50% reduction in fruit setting and final fruit yield.

Other factors that could be responsible for the low fruit numbers include blossom drop, a situation whereby all cells and tissues at the distal and blossom ends of the plant stems fail to receive enough moisture to maintain their growth and development thereby leading to cell breakdown, flower abortion and its subsequent drop (Smart and Simmons, 1995; Berrie and Berrie, 1990). This was observed on some treatment levels at varying degrees, and was highest especially under T_4 where the water stress coupled with higher night temperatures favored the extent of flower failure and could be responsible for the significant differences in the mean number of fruits between T_1 against T_4.

T_1 remarkably produced the heaviest fruits in both experiments weighing 48.9g and 32.7g, respectively. This was followed by T_2, T_3 and T_4 in both experiments. When these results were subjected to analysis of variance, T_1 was not significantly different from T_2 but was significantly different from T_3 and T_4 in experiment one. In that same experiment T_2 and T_3 were not significantly different from each other as well as T_3 and T_4. However in experiment two, T_1 was significantly different from T_2, T_3 and T_4.

The mean fruit weight per treatment was also significantly affected by different water application. Significant differences were observed in experiment one between T_1 (48.9g), T_3 (33.8g) and T_4 (25.4g) but there was no significant difference between T_1 (48.9g) and T_2 (39.9g).

According to Leung (2001) fresh hot pepper fruits contain about 60-90% water. This accounted for the highest mean fruit weight recorded by treatment one which received the highest amount of water applied. Fruits are made up of carbohydrates in the form of simple sugar which are produced by the plant green chlorophyll pigments in combination with sunlight, water, carbon dioxide in the process of photosynthesis. When this process is reduced due to reduced water requirement, the sensitive phytochrome pigments (chlorophyll pigmentation) that intercept sunlight for the process which is affected tend to reduce leaf area as well as leaf size therefore, subsequently, leading to reduced fruit weight (Pill and Lamberth, 1980). The greatest mean fruit weight obtained by T_1 also confirms the assertion by Alvino *et al*. (1994) that pepper leaves photosynthesize more efficiently when water is abundant, resulting in higher percentage of large, heavy marketable fruits.

T_1 again produced the highest yield in tons per hectare recording 2.44 t/ha in the first experiment against 1.63t/ha in the second experiment while T_4 produced the least yield of 1.27 t/ha recorded in the first experiment and 0.24t/ha in the second experiment. However, the total yield of the various treatments recorded for the first experiment was 7.39 t/ha against 3.45 t/ha recorded in the second experiment.

The mean yields commonly obtained from open pepper fields in Ghana is from 1.5-18 t/ha, (Norman, 1992), 13.4 t/ha (FAO, 1999) and 15-55 t/ha (Sinnadurai, 1992). In comparing this research work in tons per hectare, 7.39 ton/ha which was produced during the first experiment falls within the range observed by Norman (1992). The rather low yield in the second experiment is attributed to a high incidence of fruit drop which was recorded during the harvesting stage.

NPK levels

Soil N, P and K levels for the initial stage were 0.760%, 139.76µgP/g and 0.890cmolkg^{-1}, respectively. Soil NPK levels for the late stage of the various treatments are shown in Figures 1, 2 and 3.

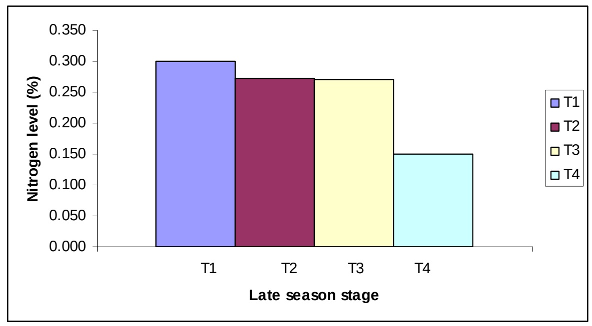

Figure-1. Levels of nitrogen in the soil at the late season stage.

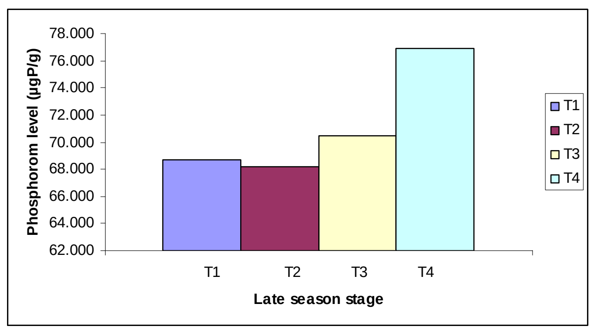

Figure-2. Levels of phosphorous in the soil at the late season stage.

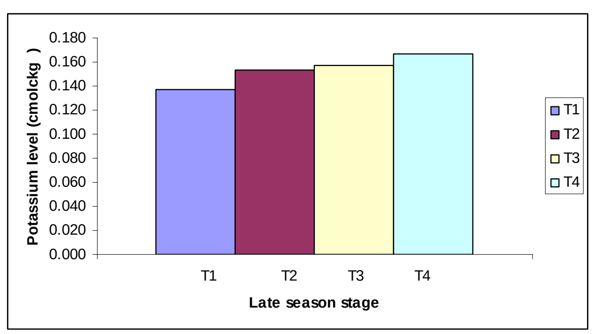

Figure-3. Levels of potassium in the soil at the late season stage.

The chemical analysis of the soil indicated that the essential nutrients in the soil were optimum to support the growth of the crop (Perur *et al*., 2003). Therefore there was no need to add soil nutrients to improve the fertility of the soil. The uptake of nutrients such as nitrogen, phosphorous and potassium by plants is influenced by the amount of water available in the soil. The results from the study indicates that T_4 utilized the most N, where as T_2 and T_1 utilized the least N. With regards to K, utilization was greatest under T_1. This is in agreement with work done by Owusu-Sekyere *et al*. (2010) who recorded an increase in the uptake of potassium as the amount of water uptake by plant is increased. Adequate amount of water in the soil tend to enhance aeration and this, according to Cline and Erickson (1956), would improve potassium and nitrogen uptake. However in this research, increased water application did not favor uptake of nitrogen since T_4 recorded the most N that was utilized. This also conforms to the earlier research work by Owusu-Sekyere *et al*. (2010).

CONCLUSIONS

The growth rate and yield of hot pepper were influenced by water supply. The water requirement and crop coefficient of hot pepper were determined for the various growth stages using an irrigation interval of two days from two field experiments. At 100% water application (full irrigation), the crop coefficients for hot pepper were determined to be in the ranges: 0.41-0.74, 0.72-0.83, 0.98-1.03 and 0.5-0.74 for the initial, developmental, mid-season and the late season stages respectively and the total amount of water applied for the 118 days ranged between 320mm and 432mm.

It was noted that the water use pattern has a significant effect on the yield and agronomic parameters of the crop as was observed in the mean leaf areas of the late season stage of pepper growth. Mean leaf areas recorded in that season were significantly reduced because irrigation ceased 15 days before readings were taken.

It is also important to note that 20% deficit irrigation has no significant reduction on the yield of hot pepper but above this threshold there is an adverse effect on the plant and yield as indicated by T_4 which recorded the lowest yield of 1.27 t/ha in the first experiment and 0.24 t/ha in the second experiment.

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