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MODELED WATER REQUIREMENT of POTATO (Solanum tuberosum L) ON JOS PLATEAU, NIGERIA.

G. O. CHUKWU[1] and M. C. IGBOKWE[2]
1.National Root Crops Research Institute
Nyanya Sub-station,
P.O. box 9682, Garki, Abuja.
E-mail: nrcri@abujanipost.com.ng
2 National Root Crops Research Institute, Umudike,
P.M.B. 7006, Umuahia, Abia State.
E-mail: nrcri@Infoweb.abs.net
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ABSTRACT

Water requirements of potato (Solanum tuberosum L) in Jos Plateau, Nigeria was accessed from climatological data using the modified Blaney – Criddle equation. Results showed that the mean seasonal crop water requirements (ET_{crop}) of 231.4 mm and 327.6 mm in the dry and rainy cropping seasons respectively were not statistically (P=0.05) different. Mean ET_{crop} for dry season cropping increased with maturity periods, in the magnitude of 249.0, 313.7 and 350.9 mm respectively for early, medium and late maturing varieties. Seasonal irrigation water requirement was zero for rainy season cropping irrespective of maturity period but 228.3, 288.3 and 327.6 mm respectively for early, medium and late maturing varieties. The results will serve as a basis for judicious water management decisions to harness the full benefits of dry season cropping and boost potato production in Nigeria.

Keywords: Water requirements; potato (Solanum tuberosum); seasonality;

INTRODUCTION

Potato (Solanum_tuberosum L.) is regarded as the most efficient root crop in Nigeria, in terms of tuber yield and days to maturity (Okonkwo et al. 1995a). There is increasing demand for potato as food, feed and industrial raw materials. This has probably, stimulated dry season cropping within the Jos, Plateau (Okonkwo et al. 1995b), to supplement yields from rainy season cropping. Dearth of information on water requirements of potato in Nigeria limits the effectiveness of dry season cropping. This gives room for water misuse and its adverse effects on crop production and the environment. For instance, Okonkwo et al (1995b) reported that potato scab (Streptomyces scabis), late blight (Phytophthora infestans) and tuber exposure to rodents and to sun were intensified by moisture stress and excessive rainfall respectively. Water requirements of potato range from *500*-700mm (FAO, 1986) and 500-600mm in Uta U.S.A. (Haris and Pittman, 1975). Judicious use of water resources input for dry season cropping is a viable option for achieving food security and accelerating agro-industrial development in Nigeria (Chukwu, 1995; 1997, 1999).

The objectives of the study were to establish crop water requirements and irrigation water requirements of potato in the Jos Plateau, Nigeria.

MATERIALS AND METHODS

Jos Plateau is located about latitudes 9° – 10° 45'N and longitudes 8° 40°' – 9° 50' E in the Guinea Savannah of the middle belt agro ecological zone of Nigeria. The elevation ranges from 1100 – 1400m above sea level.

The study was based on 11 years meterological data of Vom (Table 1), typical of the study area, extracted from Okonkwo et al (1995b).

Planting periods chosen were 1st November – 30th January for dry season cropping and 13th May – 10th August for rainy season cropping, as recommended by Okonkwo et al. (1995b). Planting dates cut across early, medium and late maturing varieties (Table 2).

Table 2: Growth Stages of Early Medium and Late Maturing Potato Varieties

	Maturing Period (Days)		
Growth Stage	Early	Medium	Late
Initial	15	15	15
Crop-development	20	25	25
Midseason	20	25	30
Late-season	10	15	15
Total (days)	65	80	90

Table 3: Adaptability of Potato Varieties to Cropping Se

Dry Season	Rainy Season	All Seasons
Cardinal[m]	Kondor[m]	Nicola[m]
RC 767-2[l]	Desiree[m]	RC 777-3[l]
Rosline ruaka[l]	Delcora[m]	Arka[m]
Biamant[m]	Famosa[l]	Greta[m]
		B94462-1[m]
		B7906-[e]
		BR63-81[e]

Where e = maturing varieties l = late maturing varieties m = medium maturing varieties

Differences in adaptability of potato varieties to seasonality (Table 3) was also considered in the choice of planting dates. Crop coefficients of 0.45, 0.75, 1.50 and 0.85 for initial, crop development, mid-season and

late season stages of growth respectively, were taken from FAO (1986).

Crop water requrement (Et_{crop}) was calculated based on the latest modification of the Blaney-Criddle formula (FAO, 1986) as applied by Chukwu (1995), 1997, 1999) in estimating water requirements of root crops and food legumes in south-eastern Nigeria.

The Blaney-Criddle formula is one of the empirical formulae that use climatic data to estimate crop water requirements. It is simple to use but can give inaccurate results under extreme climatic conditions such in windy, dry (< 50% relative humidity),or in calm, high humid (<80% relative humidity, and clouded areas (FAO, 1986). However, the modification of the original equation (FAO, 1986) provided for adjustment s under extreme climatic environment to get reliable results. The procedure is summarized below.

Reference crop evapotranspiration (ET_o) which accounts for the effect of climate on crop water requirement (ET_{crop}) was calculated thus:
$ET_o = P(0.46T + 8)$... (1)

Where P = mean daily percentage of annual day-time hours of Jos (latitude 10°N) for November, December, January, May, June, July and August.

Monthly crop coefficient (Kci month^{-1}) = $\frac{KcNi}{30}$....(2)

Where Ni = number of days growth stage lasted in a month (30 days) within a particular growth stage's coefficient represented by Kc. The Kci was rounded to nearest 0.05 or 0 (FAO, 1986).

The $ET_{crop}$was related to ET_o as follows:

$ET_{crop} = ET_o \times Kci \times 30$ ... (3)
Where Kci = crop coefficient. All months were assumed to have 30 days.

Seasonal ET_{crop} was calculated as a summation of daily values thus:

ET_{crop} (mm season $^{-1}$) = $\sum_{I=1}^{65,80,90} ET_{crop}$ (mm day $^{-1}$) ... (4)

Where 65,80 and 90 represent maturity periods (days) for early, medium and late maturing varieties respectively.

The ET_{crop} obtained in the

Table 4: Crop Water Requirement (ET_{cropmm}) of Potato in Relation to Maturity Period and Season

Maturity Period	Dry Season Cropping	Rainy Season Cropping	Maturity Period Mean
Early maturity variety	228.3	269.7	249.0
Medium maturity variety	288.3	339.0	313.7
Late maturity variety	327.6	374.1	350.9
Seasonal Total (mm)	844.2	982.8	
Mean	281.4	327.6	

rainly and dry seasons were compared statistically using student's T-test.

RESULTS

Crop Water Requirement (ET_{crop})

The ET_{Crop} is presented in Table 4. The late maturing varieties require 10.4% and 38.7% more water than medium and early maturing varieties respectively during rainy season cropping. Similarly, in the dry season cropping, late maturing varieties require 13.6% and 43.5% more neater than the meduim and late maturing varieties. Seasonal ET_{crop} in rainy season cropping was not significantly (P=0.05) different from that of dry season, even though it was 16.4% higher than the ET_{crop} during dry season cropping. The results contrasted sharply with the observations in South-eastern Nigeria by Chukwu (1088b) with sweet potato, Chukwu and Mbanaso (1999) with radish and Chukwu (1999) with groundnut and soyabean respectively where ET_{crop} in the dry season consistently

Table 5: Irrigation Water Requirement (IN mm) of Potato

Maturity Period	Dry Season	Rainy Season
	----------(IN mm)----------	
Early maturity variety (65)	228.3	269.7
Medium maturity variety (80)	288.3	339.0
Late maturity variety (90)	327.6	374.1

exceeded that of rainy season cropping.

Irrigation Water Requirement (IN)

Irrigation water requirement (IN) was zero during rainy season cropping but equals ET_{crop} during dry season cropping (Table 5).

The result is not surprising since dry season cropping fell within absolutely dry period with no rainfall (Table 1).

DISCUSSION

Mean air temperature ranged from 17.5 – 20.5°C in the dry season as against 19.5 – 22°C during the rainy season cropping. This explained why the crop required more water in the rainy season to meet higher evapotranspiration demand than in the dry season. In the South-eastern Nigeria, temperatures are higher in the dry than rainy season. This accounted for the discrepancy in trend between the results obtained and those reported by Chukwu (1995; 1988b; 1999). The mean ET_{crop} obtained (249-350.9mm) is lower than 500-700mm reported by the FAO (1986). This could be explained by the lower range of total growing period of potato (65-90 days) on the Jos Plateau of Nigeria (Okonkwo et al. (1995b), when compared with 105-145 days growing period on which the FAO recommendation was based.

CONCLUSION

Results showed that in the Vom area of Jos Plateau, Nigeria, crop water requirement (ET_{crop}) would be higher in the rainy than in the dry season. The ET_{crop} varied directly with maturation period of varieties. If rainy season cropping was done at the appropriate time,

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