INTER-RELATIONSHIPS BETWEEN YIELD AND YIELD ATTRIBUTES
OF POTATO GROWN UNDER SUPRA-OPTIMAL AMBIENT TEMPERATURES

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(Received 27, August 2007; Revision Accepted 29, August 2008)

ABSTRACT

Forty eight potato genotypes were evaluated in Saminaka (Lat. 10° 27'N and Long 4°E, Mean Min. Temp 25°C, Mean Max Temp 31.5°C) during the rainy season of 1999 and 2000 to determine the inter-relationship between yield and some important agronomic traits in the potato grown under high ambient temperatures. The genotypes were laid out in a randomized complete block design with three replications. The genotypes exhibited highly significant variability (P<0.01) for all traits assessed. Tuber yield was positively associated with number of stems/plant (r = 0.246, P<0.05); plant height (r = 0.206, P<0.05); and number of leaves/plant (r = 0.237, P<0.05). Both the correlation and regression of yield on days to tuber initiation and days to maturity were negative and significant. This suggests that earliness in tuber initiation and maturity led to increased yield under supra optimal temperature probably due to reduced period of exposure to heat stress. Number of tubers per plant (R^2 = 0.383) and average tuber weight per plant (R^2 = 0.125) had the highest coefficients of determination of yield and by far the highest direct effects on yield (87.5% and 66.9% respectively) when compared to other attributes suggesting that they were the major contributors to yield under supra-optimal temperature conditions and may be relied upon in selecting for improved yield under such conditions.

KEYWORDS: Potato, genotypes, supra-optimal temperature, tuber yield, selection

INTRODUCTION

The Potato Solanum tuberosum L is generally best adapted to cool temperate zones (Hawkes, 1978). The optimum temperature for tuber formation and growth for most potato cultivars is about 15-20°C (Borah and Milthorpe, 1962). In tropical lowland parts of Africa, potatoes are exposed to day and night temperatures far above the optimum. Almost all potato cultivars bred in northern latitudes respond to such conditions with delayed emergence (Allen, et al. 1992), excessive haulm growth at the expense of the tubers (Ewing, 1981), increased rate of respiration (Sale, 1974), reduced dry matter accumulation (Bushnell, 1925), delayed tuber initiation (Menzel, 1980, Nowak and Coleborne, 1989) and maturity (Amadi, 2005) and a significant loss of tuber yield and quality (Levy, 1983, 1984). The adverse effect of high temperature on tuber yield and quality of potato is a major constraint for potato production in hot regions, and local breeding for heat tolerant cultivar is necessary to improve potato crops in hot environment (Levy, 1984). Analysis of the inter-relationship among important agronomic characters in the available germplasm is vital to the attainment of the objective of breeding for heat tolerance. The objective of this work is to furnish information on the inter-relationship between yield and yield components with a view to identifying characters of utmost importance which can be used as selection indices for tuber yield improvement in the potato germplasm exposed to heat stress prevalent in locations with supra optimal temperatures.

MATERIALS AND METHODS

Field experiments were carried out in Saminaka during the rainy season of 1999 and 2000. Saminaka is situated at Lat. 10° 27'N and Long 4°E in Kaduna State of Nigeria. Ambient temperature and rainfall data of Saminaka for the relevant months covering the duration of the experiment in 1999 and 2000 are shown in Fig 1. Forty-eight potato genotypes were evaluated. These genotypes were laid out in a randomized complete block design with 3 replications. Net plot size was 6m^2 and gross plot size was 12m^2. The seed tubers were planted at the rate of 1 tuber per stand, inter-row spacing of 1m and an intra-row spacing of 30cm giving a plant density of 33,333 plants per hectare. Weeding was carried out manually at 4 and 8 weeks after planting (WAP). Fertilizer was applied by band placement at the rate of 100kg N, 100kg P_2O_5 and 40kg K_2O per hectare two weeks after planting (WAP). Fertilizer was applied by band placement at the rate of 100kg N, 100kg P_2O_5 and 40kg K_2O per hectare two weeks after planting. No fungicides were applied. The plants were harvested when the leaves began to senesce. Desiree, a cultivar well known for some degree of heat tolerance (Midmore, 1984) was used as a check.

Data were collected on the following attributes: seedling emergence at 4 WAP, number of stems per plant, plant height (cm), number of leaves per plant, C. O. Amadi, National Root Crops Research Institute Umudike, Potato Programme Kuru, PMB 04 Vom, Jos, Nigeria.
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days to tuber initiation, days to maturity, severity of early blight, number of wilted stands, number of tubers per plant, average tuber weight/plant, and tuber yield per plant. These attributes were measured as follows

Seedling emergence:- Emergence per plot was recorded at 4 weeks after planting by counting the number of stands whose shoots have broken though the soil surface.

Number of stems per plant:- Only the main stems i.e. those originating from the mother tubers were counted. The record was taken at full flowering.

Plant height (cm):- Plant height was obtained by measuring from the base of the plant to the apical bud. The measurement was taken at the 8th week after planting.

Number of leaves per plant:- The compound leaves from the base to the tip of the plants counted at 8 weeks after planting.

Days to tuber initiation:- This was counted from planting to the time when the first tuber is initiated by any plant in the plot. A plant was considered to have formed tubers when the swelling at the end of the stolon was twice by visual estimates the diameter of its stolon. To observe this the soil around the base of the plants were carefully removed to expose the stolon and replaced after observation.

Days to maturity:- This was obtained by counting the number of days from planting to the time when less than 50% of the canopy remain green.

Early blight severity:- Early blight severity was recorded at 10 weeks after planting based on a scale developed by Martin and Thurston, (1987). The scale ranges from 1 to 9 with a mid point of 4.

1 = No blight spots seen on the foliage
4 = 25 –50% of the foliage infected by blight
9 = foliage completely covered/killed by blight.

Incidence of bacterial wilt:- The number of stands with bacterial wilt symptoms per plot.

Number of tubers per plant:- This was obtained by counting the whole tubers produced by a plant.

Average tuber weight per plant:- This was obtained by dividing the total weight of the tubers produced by each sampled plant by the number of tubers.

Tuber yield:- The total weight of tubers/plant

Statistical analysis was performed on plot means for all attributes. Analysis of variance, regression analysis, multiple correlation and regression were carried out using the STATVIEW for windows software. Simple correlation analysis was carried out according to the method outlined by Gomez and Gomez, (1984) where

\[ r = \frac{\sum xy}{\sqrt{(\sum x^2)(\sum y^2)}} \]

Path-coefficient analysis was carried out according to the method outlined by Dewey and Lu (1959).

RESULTS AND DISCUSSION

Analysis of variance

The analysis of variance (ANOVA) is summarized in Table 1. The mean values of the various attributes are shown in Table 2. There were significant differences between the potato genotypes in all the attributes assessed. Variations among the potato genotypes for different traits have been reported by various authors (Sidhu and Pandita, 1979; and Birhman and Kang, 1993). Highly significant variability in plant attributes within a population suggests the existence of sufficient variability upon which selection for improvement in these attributes can be based.
**Table 1:** Values of sum of squares (SS), mean squares (MS) and variance ratios (VR) from ANOVA for plant attributes in Saminaka (1999)

| Attributes                     | Source of variation | SS    | MS    | VR  |
|-------------------------------|---------------------|-------|-------|-----|
| Plant Emergence               |                     |       |       |     |
|                              | genotype            | 127.97| 2.72 | 2.92*** |
|                              | error               | 87.57 | 0.93 |     |
| Number of stems/plant         | genotype            | 26.28 | 0.56 | 5.18*** |
|                              | error               | 10.14 | 0.11 |     |
| Plant height                  | genotype            | 6729.07| 143.17| 18.49*** |
|                              | error               | 727.97| 7.74 |     |
| Number of leaves/plant        | genotype            | 55193.47| 1174.33| 55.60*** |
|                              | error               | 1985.54| 21.12 |     |
| Days to tuber initiation      | genotype            | 2762.89| 58.79 | 2841.83*** |
|                              | error               | 1.94  | 0.02 |     |
| Days to maturity              | genotype            | 2706.64| 57.59 | 233.81*** |
|                              | error               | 23.15 | 0.25 |     |
| Early blight severity         | genotype            | 51.97 | 1.11 | 21.20*** |
|                              | error               | 4.90  | 0.05 |     |
| Number of wilted stands       | genotype            | 80.33 | 1.71 | 3.64*** |
|                              | error               | 44.15 | 0.47 |     |
| Number of tubers/plant        | genotype            | 154.73| 3.29 | 3.49*** |
|                              | error               | 88.81 | 0.95 |     |
| Average tuber weight          | genotype            | 9129.50| 194.25| 3.37*** |
|                              | error               | 5414.38| 57.60 |     |
| Tuber Yield/plant (g)         | genotype            | 191922.57| 4083.46| 3.14*** |
|                              | error               | 122457.76| 1302.74|     |
Table 2: Mean for various potato plant attributes studied at Saminaka the year 2000

| Genotype     | %Emergence (4WAP) | Number of Stems/plant | Number of Leaves/plant | Days to Tuber Initiation | Days to Maturation | Early blight severity | Number of wilted stands/m² | Number Tuber/plant | Average Tuber Yield (t/ha) |
|--------------|-------------------|-----------------------|------------------------|--------------------------|-------------------|----------------------|---------------------------|-------------------|---------------------------|
| 392286.14    | 80                | 1.43                  | 46.1                   | 62.1                     | 49.0              | 97.0                 | 4.0                       | 1.00              | 4.8                       | 34.0              | 5.44                     |
| RC7716-17    | 90                | 2.03                  | 46.0                   | 41.3                     | 48.0              | 81.0                 | 5.0                       | 0.89              | 3.5                       | 38.4              | 6.28                     |
| Nicola       | 80                | 1.27                  | 39.3                   | 40.1                     | 50.0              | 92.0                 | 5.0                       | 0.33              | 2.3                       | 34.5              | 2.65                     |
| Kondor       | 73                | 1.60                  | 46.3                   | 38.1                     | 54.0              | 94.0                 | 3.0                       | 1.22              | 4.8                       | 43.0              | 6.31                     |
| 391538.3     | 80                | 1.30                  | 42.2                   | 52.4                     | 50.0              | 89.0                 | 3.0                       | 1.22              | 4.7                       | 32.0              | 4.76                     |
| RC777-8      | 80                | 2.40                  | 44.1                   | 53.6                     | 59.0              | 88.0                 | 3.7                       | 1.11              | 3.3                       | 39.2              | 4.28                     |
| Baraka       | 83                | 1.80                  | 41.6                   | 43.7                     | 46.0              | 92.0                 | 3.0                       | 0.89              | 6.0                       | 32.4              | 6.28                     |
| 392011.041   | 67                | 1.20                  | 45.5                   | 35.8                     | 57.3              | 91.0                 | 4.0                       | 1.00              | 2.8                       | 40.8              | 3.93                     |
| RC7716-3     | 87                | 1.30                  | 54.3                   | 64.1                     | 51.0              | 83.3                 | 3.0                       | 1.00              | 2.6                       | 36.8              | 3.15                     |
| 392277.41    | 90                | 2.07                  | 50.2                   | 51.5                     | 45.0              | 85.0                 | 4.0                       | 0.89              | 7.1                       | 33.1              | 7.00                     |
| 392225.047   | 67                | 2.50                  | 52.3                   | 47.7                     | 49.0              | 87.0                 | 3.0                       | 0.89              | 2.9                       | 56.1              | 4.65                     |
| 392287.048   | 83                | 1.53                  | 53.3                   | 45.3                     | 58.7              | 90.0                 | 3.0                       | 1.11              | 3.2                       | 37.0              | 3.89                     |
| ML98.12      | 87                | 1.53                  | 45.2                   | 43.7                     | 49.0              | 92.0                 | 4.0                       | 1.11              | 3.1                       | 40.5              | 3.89                     |
| B9449-17     | 83                | 1.70                  | 36.5                   | 46.0                     | 54.0              | 87.7                 | 3.3                       | 0.89              | 5.2                       | 32.8              | 5.26                     |
| Alpha        | 63                | 1.60                  | 43.0                   | 52.7                     | 60.0              | 98.0                 | 3.0                       | 1.11              | 2.6                       | 37.2              | 3.22                     |
| 392243.048   | 63                | 1.53                  | 44.8                   | 41.6                     | 49.0              | 87.0                 | 3.0                       | 1.33              | 3.2                       | 35.0              | 3.54                     |
| BR63-18      | 80                | 2.40                  | 45.9                   | 33.1                     | 45.0              | 86.0                 | 4.0                       | 1.78              | 3.2                       | 47.5              | 5.15                     |
| WC732-1      | 73                | 2.63                  | 42.3                   | 87.6                     | 50.0              | 90.0                 | 4.0                       | 1.67              | 4.0                       | 39.8              | 5.65                     |
| Greta        | 63                | 2.20                  | 43.8                   | 44.3                     | 58.0              | 94.9                 | 4.0                       | 0.89              | 3.1                       | 44.0              | 3.85                     |
| LadyChriste  | 63                | 1.87                  | 45.9                   | 42.9                     | 55.0              | 92.0                 | 4.0                       | 1.11              | 3.2                       | 37.5              | 4.02                     |
| 392282.061   | 73                | 1.60                  | 40.1                   | 54.1                     | 49.0              | 92.0                 | 4.3                       | 1.00              | 4.4                       | 33.2              | 3.70                     |
| 392207.042   | 90                | 1.83                  | 36.2                   | 44.2                     | 53.0              | 88.0                 | 4.0                       | 1.00              | 2.1                       | 41.7              | 2.78                     |
| 392269.027   | 87                | 1.33                  | 49.9                   | 56.8                     | 54.0              | 98.0                 | 3.0                       | 1.00              | 2.6                       | 40.8              | 3.69                     |
| ML98.14      | 67                | 1.90                  | 47.7                   | 60.6                     | 44.0              | 86.0                 | 4.0                       | 0.89              | 3.5                       | 42.9              | 4.72                     |
| Redone       | 90                | 2.27                  | 53.9                   | 44.5                     | 50.0              | 87.0                 | 4.0                       | 1.00              | 3.9                       | 36.8              | 4.57                     |
| ML98.015     | 90                | 2.43                  | 53.6                   | 62.4                     | 48.0              | 99.0                 | 4.0                       | 1.00              | 3.2                       | 43.3              | 4.59                     |
| 392288.044   | 60                | 1.63                  | 55.2                   | 43.3                     | 50.0              | 91.3                 | 3.0                       | 1.56              | 2.7                       | 43.9              | 3.85                     |
| VC785-2      | 80                | 1.90                  | 55.6                   | 63.8                     | 51.0              | 81.0                 | 3.3                       | 1.00              | 3.6                       | 44.0              | 4.85                     |
| Roslin Ruaka | 87                | 1.30                  | 48.8                   | 54.3                     | 55.0              | 92.0                 | 3.0                       | 1.44              | 3.0                       | 44.3              | 4.28                     |
| 384300.8     | 77                | 2.27                  | 30.6                   | 35.1                     | 58.0              | 96.0                 | 3.0                       | 1.00              | 3.3                       | 34.3              | 3.59                     |
| 392010.12    | 7.3               | 2.23                  | 42.1                   | 53.1                     | 52.0              | 91.0                 | 4.0                       | 1.33              | 4.1                       | 32.9              | 4.56                     |
| Variety          | Yield | CV% | Sed   | Mean | Median | Min  | Max  | SEM | CV% | Sed   | Mean | Median | Min  | Max  | SEM |
|------------------|-------|-----|-------|------|--------|------|------|-----|-----|-------|------|--------|------|------|-----|
| 377865.35        | 73    | 1.73| 47.8  | 71.1 | 52.0   | 89.0 | 3.0  | 1.00| 5.1 | 42.5  | 6.50 |
| 392280.1         | 80    | 2.00| 42.3  | 56.8 | 47.0   | 86.3 | 3.0  | 0.89| 3.0 | 66.7  | 6.19 |
| RC7716-3         | 70    | 2.10| 60.8  | 68.3 | 51.0   | 84.7 | 3.0  | 1.22| 3.5 | 72.7  | 7.52 |
| 392282.010       | 60    | 1.37| 54.5  | 62.9 | 50.0   | 93.0 | 3.0  | 1.11| 3.7 | 44.7  | 5.24 |
| Rosamunda        | 90    | 2.23| 35.9  | 30.0 | 44.0   | 85.0 | 4.0  | 1.44| 2.9 | 32.6  | 2.76 |
| 392278.4         | 73    | 1.30| 52.4  | 46.8 | 58.7   | 90.0 | 3.0  | 1.00| 4.6 | 34.0  | 4.52 |
| LL98.01          | 70    | 1.57| 47.0  | 54.3 | 49.0   | 90.0 | 3.0  | 0.89| 3.3 | 41.6  | 4.57 |
| 392228.045       | 57    | 1.93| 34.1  | 49.6 | 44.0   | 82.7 | 5.0  | 1.44| 4.6 | 40.5  | 5.48 |
| 392281.040       | 77    | 2.07| 44.9  | 57.1 | 46.0   | 92   | 4.0  | 1.00| 5.2 | 42.2  | 6.37 |
| 392260.30        | 77    | 2.07| 46.5  | 62.4 | 50.0   | 92   | 3.7  | 1.22| 3.3 | 43.5  | 4.28 |
| 387300.8         | 90    | 1.30| 51.3  | 148.7| 50.0   | 91.7 | 3.0  | 1.00| 3.9 | 41.2  | 5.05 |
| Desiree          | 90    | 3.00| 62.4  | 110.5| 54.0   | 94.0 | 3.0  | 1.56| 5.3 | 43.3  | 7.30 |
| Famosa           | 77    | 1.83| 52.1  | 65.4 | 53.0   | 90.0 | 3.0  | 1.11| 3.7 | 42.1  | 4.94 |
| 392280.029       | 77    | 1.57| 46.7  | 45.2 | 50.0   | 90.0 | 3.0  | 1.00| 4.1 | 34.5  | 4.22 |
| 392246.017       | 67    | 1.43| 36.1  | 44.6 | 44.0   | 89.0 | 4.0  | 1.22| 4.0 | 52.0  | 6.26 |
| Accent           | 73    | 2.60| 40.8  | 44.8 | 45.0   | 90.0 | 4.0  | 1.33| 6.0 | 34.3  | 6.61 |
| Bertita          | 77    | 1.87| 56.6  | 39.3 | 46.0   | 80.0 | 4.0  | 1.33| 4.3 | 46.5  | 5.91 |
| CV%              | 12.6  | 17.8| 5.98  | 8.49 | 0.28   | 0.55 | 6.40 | 20.52| 25.56| 18.54 | 24.88 |
| SED              | 7.881 | 0.268| 2.272| 3.753| 0.117  | 0.405| 0.187| 0.187| 0.794| 6.197 | 0.982 |
Inter relationships between yield and yield components

The simple correlation coefficients between attributes studied and simple regression coefficients for the regression between yield and yield components are shown in Tables 3 and 4 respectively. Tuber yield was positively associated with stem number ($r = 0.246$, $P<0.05$); plant height ($r = 0.206$, $P<0.05$); number of leaves ($r = 0.237$, $P<0.001$) while plant height was positively correlated with number of leaves. The regression of yield on plant height, stem number and number of leaves per plant reflected the correlation. Lopez et al (1987) detected a significant positive correlation between plant height and tuber yield. Taller genotypes had more leaves, which enabled them to produce more photosynthate for storage in the tubers. This suggests that optimal shoot development is necessary for improved yields under supra optimal ambient temperature conditions. However since high temperature favour shoot growth by decreasing the partitioning of assimilates to tubers (Ewing, 1981) care must be taken not to exceed the optimum.

Both the correlation and regression of yield on days to tuber initiation and days to maturity were negative and significant. This suggests that earliness in tuber initiation and maturity led to increased yield under supra optimal temperature probably due to reduced period of exposure to heat stress.

Number of tubers per plant correlated positively with tuber yield in this study. This result agrees with the report by Lopez et al, (1987). However Birhman and Kang, (1993) reported either negative or absence of correlation between number of tubers and tuber yield. There was a highly significant positive correlation between average tuber weight and tuber yield; and a negative correlation between average tuber weight and number of tubers suggesting that selecting for increase in average tuber weight would lead to a reduction in number of tubers.

Both the correlation and regression of yield on number of tubers per plant and average tuber weight were highly significant and positive. This result agrees with the report by Lopez et al, (1987). However Birhman and Kang, (1993) reported either negative or absence of correlation between number of tubers and tuber yield. There was a highly significant positive correlation between average tuber weight and tuber yield; and a negative correlation between average tuber weight and number of tubers suggesting that selecting for increase in average tuber weight would lead to a reduction in number of tubers.

Number of tubers per plant ($R^2 = 0.383$) and average tuber weight per plant ($R^2 = 0.125$) had the highest coefficients of determination of yield (Table 5) and by far the highest direct effects on tuber yield (87.5% and 66.9% respectively) when compared to attributes (Table 6) suggesting that they were the major contributors to tuber yield under supra-optimal temperature conditions and may be relied upon as indices for selection for improved tuber yield under such conditions. Further more path coefficient analysis (Table 6) showed that the observed correlation between tuber yield and number of stems, plant height, number of leaves, days to tuber initiation and maturity were largely indirect through their effect on tuber number and average tuber weight.
Table 3: Correlation coefficient (r) between potato attributes at Saminaka in the year 2000

| Traits                              | Number of stems/pt. | Plant height | Number of leaves/pt | Days to tuber initiation | Days to maturity | Early blight severity | Number of wilted plants | Number of tubers/pt | Average tuber weight | Tuber yield/pt |
|-------------------------------------|---------------------|--------------|--------------------|--------------------------|------------------|-----------------------|------------------------|---------------------|-------------------|-----------------|
| Plant emergence                     | 0.053               | 0.098        | 0.167*             | -0.046                   | -0.031           | 0.038                 | -0.146                 | 0.000               | -0.072            | -0.006          |
| Number of stems/pt.                 | 0.043               | 0.002        | -0.136             | -0.128                   | 0.148            | 0.183*                | 0.077                  | 0.160               | 0.246**           |                |
| Plant height                        | 0.356**             | 0.094        | -0.081             | -0.362**                 | 0.058            | -0.005                | 0.235**                | 0.206*              |                  |                |
| Number of leaves/pt                 | 0.022               | 0.142        | -0.251**           | -0.370**                 | -0.100           | -0.208*               | -0.103                 |                    | 0.284**           |                |
| Days to tuber initiation            | 0.419**             | -0.370**     | -0.100             | -0.208*                  | -0.078           | -0.144                | -0.147                 | -0.165*             |                  |                |
| Days to maturity                    | -0.208*             | -0.078       | -0.044             | -0.147                   | -0.175           | -0.036                |                       |                    |                  |                |
| Early blight severity               | -0.022              | 0.054        | -0.175             | -0.372**                 | 0.619**          |                       |                       |                    |                  |                |
| Number of wilted plants             | 0.029               | -0.020       | 0.067              |                         |                  |                       |                       |                    |                  |                |
| Number of tubers/pt                 |                    |              |                    |                          |                  |                       |                       |                    |                  |                |
| Average tuber weight                |                    |              |                    |                          |                  |                       |                       |                    |                  |                |

* P<0.05, **P<0.01
Table 4: Simple regression coefficients between *tuber yield and yield components in Saminaka in the year 2000

| Attributes                  | Regression coefficient | level of significance |
|-----------------------------|------------------------|-----------------------|
| Plant Emergence             | -0.21                  | ns                    |
| Number of stems/pt.         | 19.44                  | p<0.001               |
| Plant height                | 1.33                   | p<0.05                |
| Number of leaves/pt         | 0.56                   | p<0.01                |
| Days to tuber initiation    | -3.04                  | p<0.001               |
| Days to maturity            | -1.77                  | p<0.05                |
| Early blight severity       | -2.64                  | ns                    |
| Number of wilted plants     | 3.34                   | ns                    |
| Number of tubers/pt         | 20.94                  | p<0.001               |
| Average tuber weight        | 1.60                   | p<0.001               |

* Dependent variable = tuber yield/plant

Table 5: Coefficient of determination (R²), Adjusted R² and Standard error of the estimate for the regression of tuber yield on yield components of potato in Saminaka in the year 2000

| Attributes                  | Coefficient of determination | Adjusted R² | Standard error of estimate |
|-----------------------------|------------------------------|-------------|----------------------------|
| Plant Emergence             | 0.000                        | -0.007      | 47.221                     |
| Number of stems/pt.         | 0.060                        | 0.054       | 45.772                     |
| Plant height                | 0.042                        | 0.036       | 46.209                     |
| Number of leaves/pt         | 0.056                        | 0.050       | 45.873                     |
| Days to tuber initiation    | 0.081                        | 0.074       | 45.280                     |
| Days to maturity            | 0.027                        | 0.020       | 46.578                     |
| Early blight severity       | 0.001                        | -0.006      | 47.192                     |
| Number of wilted plants     | 0.005                        | -0.002      | 47.115                     |
| Number of tubers/pt         | 0.383***                     | 0.379       | 37.096                     |
| Average tuber weight        | 0.125**                      | 0.119       | 44.161                     |

Potato tuber yield is influenced largely by the number of tubers and average tuber weight (Birhman and Kang, 1993). Lynch and Kozub (1991) observed that while number of tubers was more important in determining tuber yield in some progenies and environments, it was average tuber weight that was more important for tuber yield determination in other genotypes and environments. In this study, number of tubers was more important than average tuber weight for tuber yield determination going by its higher coefficient of determination (Table 5) and direct effect (Table 6).

Multiple correlation coefficient for the relationship between tuber yield and other attributes was highly significant and positive (0.891) (Table 7). This means that 89% variation in tuber yield can be attributed to the influence of the ten attributes assessed. The multiple regression was also very highly significant (Table 7).

Results presented in this study showed that number of tubers per plant and average tuber weight per plant were the major contributors to yield under supra-optimal temperature conditions and may be relied upon as indices for selection for improved yield under such conditions.

ACKNOWLEDGEMENTS

The authors are grateful to the Executive Director National Root Crops Research Institute Umudike for the permission to publish this work and to the technical and field staff of the Potato Programme Kuru and Kaduna State Agricultural and Rural Development Project for their assistance.
Table 6: Path analysis showing direct and indirect influences of 10 attributes on tuber yield per plant of potato genotypes in Saminaka in 1999

| Character                                      | Direct effect | Indirect effect via Character | Corr. Coef. (r) |
|-----------------------------------------------|---------------|-------------------------------|-----------------|
|                                               |               | Plant emergence (4WAP)        |                 |
| Plant emergence (4WAP)                        | 0.036         | 1                             |                 |
|                                               |               | Number of stems /Plant        |                 |
| Number of stems /Plant                        | 0.034         | 0.003204                      |                 |
|                                               |               | Plant Height (cm)             |                 |
| Plant Height (cm)                             | 0.030         | 0.003492                      |                 |
|                                               |               | Number of leaves/plant        |                 |
| Number of leaves/plant                        | 0.049         | 0.006084                      |                 |
|                                               |               | Days to Tuber initiation      |                 |
| Days to Tuber initiation                      | 0.026         | -0.001656                     |                 |
|                                               |               | Days to maturity              |                 |
| Days to maturity                              | -0.006        | -0.001116                     |                 |
|                                               |               | Early Blight Severity         |                 |
| Early Blight Severity                         | 0.075         | 0.001368                      |                 |
|                                               |               | Number of wilted stands/m²    |                 |
| Number of wilted stands/m²                   | 0.048         | -0.005256                     |                 |
|                                               |               | Number Of tubers/plant        |                 |
| Number Of tubers/plant                        | 0.875         | -0.000144                     |                 |
|                                               |               | Average Tuber weight/plant    |                 |
| Average Tuber weight/plant                    | 0.669         | -0.00252                      |                 |
| Residual                                      | 0.427         |                               |                 |
Table 7: Multiple correlation and regression of tuber yield on other potato plant attributes in Saminaka the year 2000

| Source of variation | degree of freedom | sum of squares | mean squares | f value |
|---------------------|-------------------|----------------|--------------|---------|
| Regression          | 10                | 251476.43      | 25147.643    | 51.327*** |
| Residual            | 133               | 65163.461      | 489.951      |         |
| Total               | 143               | 316639.89      |              |         |

Coefficient of determination 0.794***
Multiple correlation 0.891***
Standard error of estimate 22.135

Y = -130.94 +1.14X1 +4.33X2 +0.00X3 +0.11X4 -0.13X5 -.08X6 +3.60X7 +2.21X8+28.61X9 +2.94X10

Where: X1 = Plant emergence, X2 = Number of stems, X3 = Plant height, X4 = Number of leaves, X5 = Days to tuber initiation, X6 = Days to maturity, X7 = Early blight severity, X8 = Number of wilted plants, X9 = Number of tubers, X10 = Average tuber weight,

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