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# ANALYSIS OF YIELD AND ITS COMPONENTS IN SWEET POTATO

(*Ipomoea batatas L*)

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A knowledge of the genetic factors that influence yield in crop plants is of great value for the efficient utilisation of the available germplasm. An attempt has been made to identify such factors and to understand their relative importance in enhancing yield in sweet potato. The crop is cultivated extensively for its tuber.

## Materials and Methods

Seventeen morphologically distinct varieties of sweet potato were grown in randomised block design with four replications. Twenty four individual plants of each variety were selected at random from the replicatioas for collecting the required data.

For analysis the method suggested by Wright (1921), and recommended by Li (1955) was used. Earlier, this method had been employed successfully in field beans by Durate and Adams (1972).

In the present study, apart from yield of tuber (effect), eleven other characters (causes), as enumerated in Table 1, were analysed. The coefficients of simple and mutual correlations and the cause-effect relationships were estimated for arriving at conclusions.

## Results and Discussion

*Correlations*:

Simple and mutual correlations were worked out and the results are given in Tables 1 and 2 respectively.

It is seen, from Table 1, that highly significant positive association with yield was exhibited by girth of tuber, length of tuber and number of tubers. The association of leaf area and length of vine, to yield were significant, but in the case of the former, it indicated a negative trend. In respect of the remaining six characters, the values obtained for the coefficient of correlation were not significant.

Further, the coefficients of mutual correlation were estimated for the characters, which exhibited significant association with yield and the result is presented in Table 2.

**Table 1**

**Coefficients of correlation between yield and component characters**

| Characters | Correlation Coefficients (r) |
|---|---|
| 1. Number of days to initiation of tuber differentiation | — 0.199 |
| Number of days to flowering | + 0.266 |
| 3. Net growth in thickness of the set | – 0.192 |
| 4. Length of vine | + 0.358* |
| 5. Weight of top | - 0.270 |
| 6. Number of branches | - 0.087 |
| 7. Number of leaves | – 0.175 |
| 8. Leaf area | 0.470* |
| 9. Number of tubers | + 0.724** |
| 10. Length of tuber | + 0.802** |
| 11. Girth of tuber | + 0.807** |

Significant at 5% level. Significant at level.

It is seen from Tables 1 and 2 that higher positive values for association with yield was recorded by girth of tuber, length of tuber and number of tubers. These three characters are presumed to have comparatively closer influence on the ultimate yield than leaf area and length of vine. Further, leaf area bears a more intense association with girth of tuber than towards yield and in both cases the relationship is negative. Similarly, length of vine records a higher value for relationship towards number of tubers than that towards yield.

In the light of me above finding, the five component characters were grouped into two different orders for the estimation of the path coefficients. Girth of tuber, number of tubers and length of tuber were assigned to the first order, and leave area and length of vine, to the second order.

*Path analysis*

Path analysis was carried out for the first and second order components separately and the values for the direct and indirect effect of the components were estimated.

**Table 2**

**Coefficient of mutual correlation among yield and five characters**

| Characters. | Yield | No. of tubers. | Length of tuber. | Girth of tuber | Length of vine | Leaf area. |
|---|---|---|---|---|---|---|
| 1. Yield | x | + 0.724** | +0.802** | + 0.807** | + 0.358* | - 0.470* |
| 9 Number of tubers. | | x | - 0.047 | + 0.204 | 0.429* | - 0.426* |
| 3. Length of tuber. | | | x | + 0.398 | - 0.329 | -0.189 |
| 4. Girth of tuber. | | | | x | — 0.047 | – 0.611** |
| 5 Length of vine. | | | | | x | 0382* |
| 6. Leaf area. | | | | | | |

Significant at 5% level. * * Significant at 1% level.

*vsis of the first order components*

The value for the coefficient of simple correlation between yield and girth of tuber ( + 0.8070) is fairly high and is the sum of the positive direct effect exerted by the component yield (+ 0.4037), and the positive indirect effect of the same component exerted through the other two components of the same order, number of tubers (+ 0.2667) and length of tuber (+ 0.1366). It is seen from this relationship that about half of the extent of association of the component on yield is through direct influence. The indirect effect is directed through two different pathways one through length of tuber and the other through numDer of tubers. The greater proportion of the indirect effect is apparently through length of tuber.

The coefficient of simple correlation between yield and number of tubers is also high (+ 0.724). Here the value for direct effect ( + 0.6698) is comparatively high magnitude as against the indirect effect - through girth of tuber (+ 0.0846) and length of tuber (— 0.0304). Futher, the indirect influence of number of tubers through girth of tuber indicates a negative trend.

Length of tuber also bears a positive association with yield ( + 0.8020) and the degree of association is highly significant In this case, the value for direct effect (+ 0.6702) as weighed against the value for the coefficient of correlation is very high. The presence of indirect effect is also indicated, through the girth (+ 0.1622) and through number of tubers (— 0.0304)

**Table 3**

**Direct and indirect effects of the first order components on yield**

| Characters | Effect via | | | r |
|---|---|---|---|---|
| | Girth of tuber | No, of tubers | Length of tuber. | |
| Girth of tuber | + 0.4037 | + 0.2667 | + 0.1366 | + 0.8070 |
| No: of tubers | ∓ 0.0846 | + 0.6698 | - 0.0304 | + 0.7240 |
| Length of tuber | + 0.1622 | - 0.0304 | + 0.6702 | + 0.8020 |

*Analysis of the second order components*

**Table 4**

**Direct and indirect effect of the second order components on the first order components**

| Characters | Effect via | | r |
|---|---|---|---|
| | Leaf area | Length of Vine | |
| 1. Girth of tuber and its components. | | | |
| Leaf area: | - 0.6944 | + 0.0834 | - 0.6110 |
| Length of vine: | - 0.2652 | + 0.2182 | - 0.0470 |
| 2. Number of tubers and its component | | | |
| Leaf area | - 0.6906 | + 0.2646 | - 0.4260 |
| Length of vine | - 0.2638 | + 0.6928 | + 0.4290 |
| 3. Length of tuber and its components | | | |
| Leaf area | - 0.0742 | - 0.1148 | - 0.1890 |
| Length of vine | - 0.0284 | - 0.3006 | - 0.3290 |

values underlined denote direct effect.

Girth of tuber and leaf area are significantly correlated and the association is negative (— 0.6110). The value for direct effect of this character (leaf area) is proportionately high and also negative (— 0.6944). The character exerts indirect effect through a single path only, ie. through length of vine, and the relationship is slight but positive (+ 0.0834).

The association between girth of tuber and length of vine is negligible (— 0.0470), but suggests a negative trend. The value for direct effect is + 0.2182 and that for indirect effect (through leaf area) is — 0.2652. Eventhough the values for direct and indirect effect in this case are almost equal, by virtue of their possessing opposite signs, the overall effect is considerably reduced to almost negligible magnitude.

Number of tubers, shows significant association with leaf area (—0.4260) and length of vine (+ 0.4290). In the case of leaf area, the value for direct effect is - 0.6906 and that for indirect effect (through length of vine) is + 0.2646. The direct influence of length of vine on number of tubers is also high as in the case of leaf area, but positive (+0.6928). The value for indirect effect (through leaf area) is — 0.2638.

Length of tuber is significantly related to length of vine and the relationship is negative (— 0.3290). On the other hand, its relationship with leaf area is not significant, but indicates a negative relationship as in the former case. When the direct and indirect effects of length of vine on length of tuber are taken into consideration, the value recorded against the former is proportionately high ( - 0.3006) against that for the latter (— 0.0234). On the contrary the direct contribution of leaf area on length of tuber (— 0.0742) is apparently lower than its indirect effect through length of vine (— 0.1148).

In sweet potato, yield of tuber is influenced primarily by the three first order components, girth of tuber, number of tubers and length of tuber. The relationship in all these three cases is significantly high and positive. In the order of contribution towards increased yield, girth of tuber ranks first, followed by length of tubers. When the direct effect of girth of tuber accounts for nearly half of its total effect, that for the other two characters in much more than this proportion. At the same time the indirect effects of girth of tuber through number of tubers and length of tuber are also positive as in the case of direct effect. On the other hand, when the indirect effect of number of tubers through the girth of tuber is positive, that through the length of tuber is negative, leading to an overall dimunition in the value recorded against the indirect effect. A similar trend is noticed in the indirect effect of length of tuber on yield. in spite of the lesser magnitude of the indirect effects of these two first order components (number of tubers and length of tuber), their direct effect is much pronounced, and it is suggested that the components should be given preferential consideration over girth of tuber.

Leaf area and length of vine, which were classed as the second order components in this study, are found to influence all the three first order components, thereby rendering themselves ultimately responsible for a substantial increase in yield.

Leaf area not only bears a negative relationship to yield but also to all its three first order components. This seems to be applicable both to the direct effect as well as the indirect effect.

The relationship of length of vine to yield is positive and moderately significant. However, its relationship to the first order components show variation. Against girth of tuber and number of tubers, the direct and indirect effect indicates a positive nature, whereas the effects, direct as well as indirect, possess a comparatively lower value and show a negative relationship to length of tuber.

In the light of these findings it is therefore concluded that the vegetative character, leaf area exerts significantly high negative influence on the three tuber characters, girth of tuber, number of tubers and length of tuber, which in turn are more closely associated with the final yield of the plant. At the same time another vegetative character, length of vine, when bears positive relationship with two of the more important tuber characters, girth and number of tubers, can more effectively cause an increase in the overall yield. The character, though bears a negative relationship with length of tuber, the magnitude of this relationship is low and presumed to have only very little influence on the yield. Therefore it is suggested that in sweet potato increasing the length of vine should be preferred to increasing leaf area for obtaining higher yield. The findings are in agreement with that of Thamburaj and Muthukrishnan (1976). They report that the number of tubers and girth of tuber contribute the maximum direct effect on tuber yield, when the number of leaves has only a negative direct effect.

In this context, it is felt, that one has to exercise an element of compromise between length of vine and leaf area. Nadar (1969) reported the existence of certain degree of intravarietal variability in sweet potato, which vary from character to character. He found that the value obtained for coefficient of variation for the two characters - length of vine and leaf area are 22.49 and 44 06 respectively, and suggest the occurence of a comparatively lesser extent of intravarietal variability in respect of the former character than the latter. Length of vine is directly proportional to yield, but the relationship of the leaf area to yield is inverse. Increase in length of vine is generally accompanied by an increase in the number of leaves. It should be borne particularly in mind that attempts to increase the length of vine should always be made coupled with attempts for reducing the leaf area. Concurrent selection for smaller leaves, preferably narrow and deeply lobed, and which sport a more appropriate orientation in the overall architecture of the plant for maximum photosynthetic efficiency, should be aimed • at for evolving potentially high yielders in. sweet potato.

## Summary

Analysis was carried out for studying the yield-component inter-relationship in seventeen varieties of sweet potato. Determination of the coefficients of simple and mutual correlations and path at the levels of the first and second order components reveals that an increase in the length of vine causes significant increase in tuber yield. But at the same time, the overall area of leaf should not be allowed to increase, because this character bears a negative relationship with yield. An ideal plant type with longer vines, with small, narrow and deeply lobed leaves with appropriate orientation on the viue for effecting better photosynthetic efficiency, should be aimed at for selecting potentially high yielders.

## സംഗ്രഹം

പതിനേഴ് വ്യത്യസ്ഥ ജനസ്സുകളിൽ പെട്ട ffiCjyfDdJsils'ooralaii, കിഴങ്ങുല്പാദനവും അതുമായി ബന്ധപ്പെട്ട ജനിക ഘടകങ്ങളും തമ്മിലുള്ള പരസ്പര ബന്ധം സൂക്ഷ്മ വിശകലനത്തിനു വിധേയമാക്കിയപ്പോൾ വള്ളിയുടെ ദൈർഘ്യം കൂടുന്തോറും ഉല്പാദനം വർദ്ധിക്കുന്നതായി കാണുന്നു. തൽസമയം ഉല്പാദനം ഇലകളുടെ വിസ്തീർണ്ണവുമായി വിപരീതമായി ബന്ധപ്പെട്ടിരിക്കുന്നു. സൂര്യപ്രകാശം കാര്യക്ഷമമായി ഉപയോഗപ്പെടുത്തത്തക്കവിധം ആഴത്തിൽ കീറലുകളുള്ള ചെറിയ പത്രികകൾ സംവിധാനം ചെയ്യപ്പെട്ടിട്ടുള്ളതും നീണ്ട വള്ളികളുള്ളതുമായ ചെടികൾ താരതമ്യേന വർദ്ധിച്ച ഉല്പാദനക്ഷമത കാണിക്കുമെന്ന് ഈ പഠനം സൂചിപ്പിക്കുന്നു.


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