A CONCEPT OF 'PLANT IDEOTYPE' IN INDIAN MUSTARD (BRASSICA JUNCEA (L.) CZERN AND COSS)

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The present concept of plant breeding is to produce genotypes with a maximum of desirable characters for giving the highest economical returns. Although plant ideotype (Donald, 1968) or ideal plant type seems to be a theoretical exercise, it provides at least the guidelines for breeders in attaining their goal. Efforts have been made to define a suitable plant type in various crops. It is, unfortunately, a paradox that the yield of Indian mustard is very low where this crop has been cultivated extensively since ancient times and a considerably varietal diversity is also present. The yields are 6 Q/ha as compared to 27 Q/ha consistently produced in European countries. It is certainly true that cultural factors undoubtedly affect the yield to a large extent but the role of plant type cannot be given less weight. An attempt has therefore been made in this paper to formulate an ideal plant type of Indian mustard which is an important oilseed crop in this region.

The mustard crop is cultivated in different ways as (i) a pure crop under irrigated conditions (ii) a pure crop under conserved moisture conditions and (iii) as a mixed crop under irrigated/rain-fed conditions with other major crops, primarily wheat, barley and gram.

The conditions mentioned above complicate the architecture of the suitable plant type in this crop. Nevertheless, the understanding of different morphological characters, the present available knowledge of their genetics and inheritance would prove of immense use in developing such plant type concept. This concept is discussed under different studies as listed below.

CORRELATION AND PATH-COEFFICIENT STUDIES

The yield potential of the varieties at present cultivated is about 3500 kg/ha under high fertility and irrigated conditions with no frost and insects attack. This potential is as good as the average yield in some other countries. These varieties have a long period of growth, are very tall and profusely branched (having both the primary and the secondary branches in large number). Correlation studies reported so far (Singh et al, 1969; Yadava, 1973; Yadava et al, 1976 and Asthana and Pandey, 1977) also confirm the strong positive associations of seed yield with maturity period, plant height, primary and secondary branches, number of siliqua per plant and seeds per siliqua. The other characters such as oil content, length of main branch, pod length and seed weight have poor associations with seed yield.

Path-coefficient studies have also established the highest direct effect of the number of siliqua per plant. Other characters which influence the seed yield directly are: secondary branches, 1000-seed weight and harvest index.

The exhaustive studies conducted on variability in Indian mustard by Chandola, 1974 and Yadava and Singh, 1977 revealed a wide range of genetic variability for all the desirable characters except oil content in the seeds. It can, therefore, be envisaged that the improvement for oil content may not be possible with the genetic stock now available. The breeders have to be satisfied at present with only the increase in seed yield and total oil produced per hectare.

PHYSIOLOGICAL STUDIES

The harvest index is the factor which considerably increases the seed yield. It is seen that the harvest index of mustard plant is very poor. Genotypes vary in the harvest index and it is associated with yield. Hence, the genotype should have high harvest index. The physiological efficiency of converting a large amount of phytosynthates into economic yield is one of the very important factors which increase the harvest index leading to a physiologically efficient plant type. It is now an established fact in cereals that high yield is mainly due to high harvest index (Singh and Stoskopf, 1971). It has been shown in the studies that characters such as flag leaf, awns and dwarfness in wheat; stiff straw, thick and erect leaves and dwarfness in rice and erect leaves in maize affect the physiological efficiency of the plant. Limited physiological studies have been conducted in Indian mustard. Defoliation studies revealed that the plucking of lower-half leaves at 120 days (pod formation completed) has no effect on seed yield. This gives some indication that there is an excess of leaf area in late maturing types. The leaf area index varies from 1.25 (early type) to 2.50 (late maturing types). The optimum leaf area index for this crop has been worked out to be 2.00 (Anonymous, 1976). Physiological studies conducted by Thurling, 1974 and Anonymous, 1976 show that there are genotypic differences in the net assimilation rate, the relative growth rate and the crop growth rate in *Brassica*. Net assimilation rate, an indirect measure of photosynthesis varied from 0.334 to 0.696 g dm -2 (Anonymous 1976). Genotypes of a maturity period of less than 130 days are poor in yield primarily due to their physiological inefficiency.

FLOWERING PATTERN

Correlation studies have shown that there is a positive correlation between early flowering and maturity (Yadava et al, 1976). It has been observed that there is an increase in seed yield with the increase in span of flowering. In addition the long flowering span will work as a bulwark against the changing environment which plays an important part.

In conclusion, the ideal plant type for modern agronomy for higher yield should be a physiologically efficient genotype with optimum vegetative growth, late maturity (150 to 160 days), long span of flowering, tall, profusely branched (both primary and secondary branches), large number of siliqua per plant, higher number of seeds per siliqua (20-25) with 40% oil content in seeds (Fig. 1). The plant should be resistant to different diseases and insects and pests. It should also be frost resistant.

For the rain-fed/dry-land conditions, the experiments conducted clearly show that genotypes found suitable under irrigated conditions perform poorly under dry-land conditions. This is primarily due to a long maturity period and a heavy vegetative growth (Anonymous, 1976). The poor yield in long-maturing varieties is due to water-stress conditions prevailing at later stage of crop growth affecting the development of the seed. Under these conditions, early-maturing types (120-130 days) perform well because these genotypes complete their life cycle early and thus evade the stress conditions. Experiments show (Anonymous, 1976) that genotypes which mature very early (in less than 120 days) do not yield satisfactorily, primarily due to their poor vegetative growth, less branching, smaller number of pods, smaller seeds and weak straw. Reducing the maturity period and maintaining the other characteristics as under the best conditions will constitute the ideal plant type for such conditions. In addition, a deeply extended root system will be a very important characterstic for rain-fed conditions (Fig. 2).

For the third condition, the crop is grown mixed with other crops such as wheat, gram and barley to attain the maximum net return from such crops grown under dry-land conditions. Shadding is the one major factor which drastically affects the main crop yield. Therefore, the mustard genotypes should have erect-growth habit which is possible if genotypes have appressed branching (Fig. 3) and the non-shattering habit. Non-shattering habit is very important due to the fact that it is not practically possible to combine the maturity period of both these crops. Generally mustard crop matures earlier and if not combined with this character, the seeds produced will shatter and thus giving a very low yield.

The screening of germplasm for these characters revealed enough variability (Yadava and Singh 1977). Genotypes like 'appressed mutant' dwarf varitey have been found to possess erect and compact branching and pods. These characters have been observed in tall and dwarf background and in various maturity groups. One strain, RH-30, possesses non-shattering habit with bold seeds and has been identified as a good genotype for mixed cropping.

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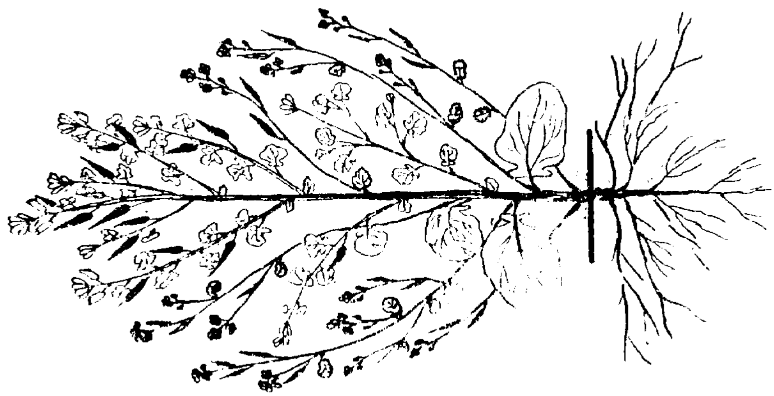

Fig. 1.

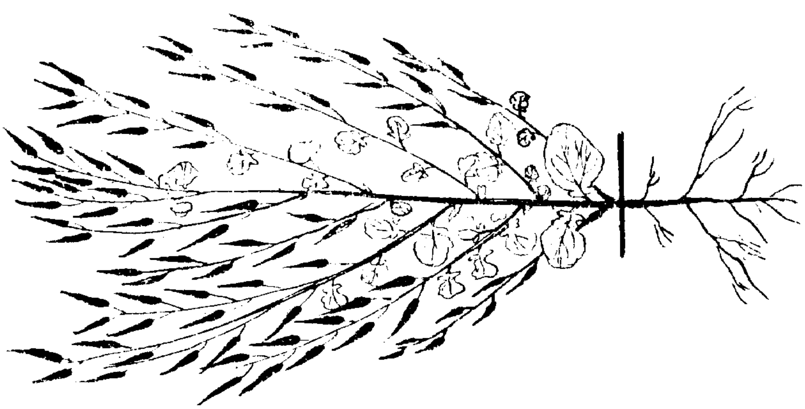

Fig. 2.

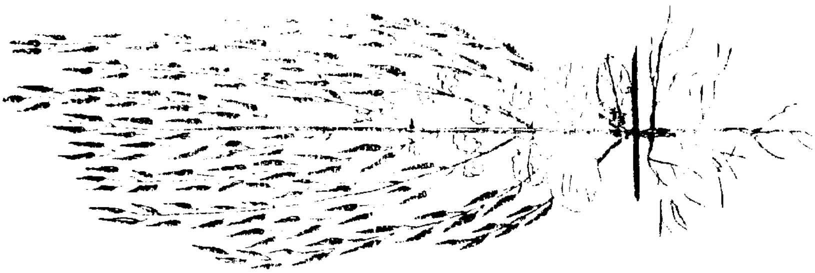

Fig. 3.

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