SCOPE FOR THE SUCCESS OF TRIPLE DWARF WHEAT AND STEPS REQUIRED FOR FURTHER IMPROVEMENT*

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Triple dwarf is a term applied to wheats which are thought to have three genes for dwarfing. The exact genetic make up is unknown; that is, these triple dwarfs may actually have three major recessive genes for dwarfing, or may have two major recessive genes for dwarfing plus some mofifying genes. The term triple dwarf also refers to a specific height level. The lines or varieties classified as triple dwarfs reach heights of only 60-80 cm. under irrigated conditions and with high levels of fertilization. This height may vary with the environment and the number of modifiers present in the variety or line.

The inherent short plant height of triple dwarfs permit their thick planting and heavy fertilizations without subsequent lodging. On the other hand, it is generally associated with several undesirable agronomic traits e.g; crowding of foliage, short coleoptile length, leaf firing, sterility of floret, reduction in grain number per spike and shrivelled grains. Such strains, therefore, are unable to respond even to good crop management. The scope of present day triple dwarf varieties is limited to very sophisticated crop management systems. And, if such genotypes are grown without special care, they do not exhibit

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their superiority in grain yield, and in many cases, their yield are reduced due to poor seedling emergence and reduced crop stand.

There is lot of variability present in the triple dwarf group of wheat material for these agronomic traits. In the past few years significant improvements have been made with regard to these characters. However, still there is plenty of scope for the improvement of triple dwarf varieties in this respect.

In recent years, a number of triple dwarf cultures have been tested at a large number of locations through the All India coordinated Wheat Trials. Majority of the cultures have proved inferior to Kalyansona in plant type, disease resistance and yield. However, some of them have proved their superiority to Kalyansona in yield and other plant characters. It has also been observed that the application of fertilizers after a certain point is not efficiently utilized by triple dwarf varieties for increased grain productivity, even if the plants do not lodge at that level.

Results of the experiment conducted, at U.P. Agricultural University during rabi 1970-71, on the response of triple dwarf wheats to nitrogen (Dr.K.C. Sharma and associates) are given in Table 1.

Table 1. Grain yield (Kg per hactare) as influenced by rates of nitrogen and varieties (1970-71)

Varieties	Rates of nitrogen (Kg/ha) 0	40	80	120	160	200	Mean
Kalyanson	3746	4181	5993	5727	4978	4326	4825
U.P. 301	3432	3456	5099	5703	5897	6162	4958
Hira	3456	4277	5969	6211	6694	6767	5562
U.P. 310	3263	3673	5268	6162	6452	6452	5211
Mean	3474	3897	5582	5951	6005	5927	

	N rates	Varieties	N x V
C.D. at 5%	330.5	378.4	(i) for N 611.6 (ii) for varieties 550.8

The yield levels obtained without fertilizer application are rather high and indicate that basal fertility in the soil must be sufficiently high. Therefore, it would be safter to assume that the actual fertility in the soils must have been highter at all the levels than that given in table 1. Kalyansonal seems to give highest yield at fertility level of 80-120 Kg. N per hectare and at progressive fertilization, the yield decreased correspondingly. However, in-case of triple dwarf varieties viz. U.P. 301, Hira and UP 310, the yield did not decline even at 200 Kg. N per hetare. Although none of the triple dwarf varieties lodged, UP 301 gave consistently lower yields as compared to Hira and UP 310 at all levels of nitrogen application. This clearly indicated that even within three gene dwarfs, there is differential response to nitrogen application for grain yield. This indicates the scope for further improvement in the triple dwarf varieties. We should look for those varieties, which are responsive to moderate (120 kg N per hectare) as well as higher doses, (200 kg N per hectare or more) of fertilization and, of course, with economic returns.

In All India Coordinated Wheat Programmes, the three gene dwarf varieties are being raised under the crop management practices suitable for one or two gene dwarf varieties. There are some cultures in triple dwarf wheats, which seem to respond at higher levels of nitrogen application. But at present they are being discarded because of their unability to express full yield potential at 120 kg N per hectare or less. However, these cultures may best be suited to those leading farmers, who can adopt new crop management system to exploit the high yield potential of these new plant type.

It is well known that the coleoptile length, in three gene dwarf varieties, is shorter as compared to two or one gene dwarf varieties. It is also true that, if planted deeper than 4 centimeter, the seedling emergence in three gene dwarf varieties is poorer and slower, than the two and one gene dwarf varieties. While visiting a number of experiment stations, it was observed that plant stand in many of the three gene dwarf varieties was poor and this factor alone may account for lower yields in many of the triple dwarf varieties. In many cases farmers are unable to give pre-sowing irrigation and seeds are planted deeper to put them in mobt soil. This problem will assume still greater importance, if triple dwarf wheats are to be grown in unirrigated areas. Therefore, it is necessary to evolve triple dwarf varieties with large coleoptile for wider adaptability.

Excessive foliage is one of the major draw backs of present day triple dwarf varieties. Due to heavy shading lower leaves of the plant are unable to photosynthesise and they live on the expense of food material synthesised by upper leaves and ears. This causes the reduction in the amount of net photosyntate available to be stored in seeds. Now shading reduces the aeration and increases humidity in the foliosphere. This provides condusive environment for the infestation of insect pests, and at times, previously uncommon diseases like powdery mildew becase a major disease. The desirable step in the improvement of triple dwarf varieties would be to evolve varieties with short and narrow leaves. A number of cultures have been selected at U.P. Agricultural University and other locations, where the leaf size has been reduced to one third as compared to the leaves of Kalyansona. These strains seems to have much more efficient external and internal constitution to ensure maximum photosynthesis that will provide increased net photosynthate for storage in seeds after deducting the various avenues of expenditure. Moreover, such genotypes would be planted at lower spacing and this would result in increased number of ears per unit area, resulting in increased yield.

With all our efforts of increasing nitrogen response and photosynthesising efficency of triple dwarfs, it we are not able to providethe space for the storage of net photosynthate, the outcome may be insignificant. Seeds in the heads provide this space and, therefore, effors should be simultaneously made to equip the plant with ear heads having large number of bold grains.

Results of a trial conducted at U.P. Agricultural University during *rabi* 1970-71, presented in table 2, indicate that there are some triple dwarf cultures which are superior to Kalyansona in terms of yield and yield contributing characters.

Table 2. Yield (Q/ha) and yield components in Kalyansona and some triple dwarf varieties of wheat.

Varieties	Yield (Q/ha	Seed sett%	No. of grain per spike	1000 kernel weight	No. of spike per head
1. UP 306	36.47	66.00	38.75	49.4	16.35
2. Kalyansona	44.43	76.35	62.15	34.2	18.62
3. UP 338	44.34	73.90	63.30	28.4	19.85
4. UP 301	47.25	71.31	53.70	35.6	18.00
5. UP 319	63.55	70.60	47.55	49.2	18.80
6. UP 325	63.99	74.43	55.60	40.3	19.20
7. UP 330	67.82	71.21	50.55	48.50	18.95
8. UP 332	69.42	70.07	43.40	50.8	19.30
9. UP 333	X9.59	77.10	56.75	41.70	19.00
10. UP 320	75.99	75.06	56.95	46.5	19.50

Variety UP 338, though having highest number of grains per spike and fairly high seed setting percentage, gave lower yield because of the lowest thousand kernal weight. On the other hand, variety UP 306, having second highest thousand kernel weight, gave low yields because of lowest number of spikelets per ear head and seed setting percentage. Varieties like UP 332, UP 333 and UP 320 which yielded higher, also had, in general, high seed setting percentage, number of grains per spike and thousand kernel weight. Although in the present study another important component of yield ie: number of spikes per unit area, is missing, still the following inferences can be drawn.

1. For better yields a proper combination having higher values of all the yield components is required.

2. All the components of yield can be improved side by side without subsequent reduction in any one of them.

In the past, various workers have reported definite negative association among the different yield components in wheat. However, in larger population it may not hold true. Our observations at this centre indicate that a lot of variability exists for these components of yield and it is possible to select the lines, where all the components of yield are reasonably higher, and they account for higher yield in these lines.

Reducing plant height is generally assumed to be associated with lodging resistance. However this may not always hold true. Some of the triple dwarf varieties, grown at U.P. Agricultural University during <u>rabi</u> 1970-71, did lodge because of the rains, late in the season. Lodging may become a problem in triple dwarfs, grown at higher levels of nitrogen in those areas, where the rains late in the season accompanied by strong winds are more frequent. Therefore, if we breed varieties to be grown at higher levels of fertility, it should not only be dwarf, but must also have high breaking strength of straw, rind thickness unit length weight and culm diameter.

For their wider use triple dwarf varieties should have superior grains, rich in nutrition and quality characteristics. They should have high degree of resistance to insect pests and tolerance to moisture stress. They should also fit in the crop rotations prevalent in the area of adoption.

A maximum benefit from the responsive triple dwarf varieties, so developed, can only be realized, if present day cultural practices for such three gene dwarf varieties are improved markedly. Without proper advancement in cultural practices, it is possible that these potentially productive genotypes may yield less than the highly competitive varieties now in cultivation. However, it would be a mistake to discard such varieties without giving them fair trial. We are sure that the Indian farmers, if convinced about their yielding potential, would not take much time to learn the suitable cultural requirements for these genotypes.