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Crop attributes as an indicator of the final yield— Wheat in jalgaon and Niphad

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ABSTRACT. Crop yield is the integrated effect of crop attributes. However all the crop attributes will not have similar amount of influence under different climatic *cum* soil conditions. The differential impact of crop attributes on yield of grain of wheat grown at Jalgaon and Niphad has been discussed.

Although all the four crop attributes are significantly correlated with yield when taken severally, it was found that when taken jointly, height is the significant factor at both the stations. In addition to this, shoot is a factor at Jalgaon whereas plant appears to be a factor at Niphad.

Using the crop attributes it is possible to forecast the final yield with sufficient accuracy well in advance of harvest when the crop is hardly ten weeks old.

1. Introduction

Climate-soil interaction is reflected in every aspect of the crop performance right from the time of sowing to harvest. This being so, the plant breeder aims at evolving varieties which can by and large give the best result for a given agro-climatic zone. Although yield is the integrated effect of the crop features, there is a differential emphasis in the crop under varying environmental conditions. However, for a preliminary study with meagre data, the author (Sreenivasan 1958) analysed the wheat data collected under All India Co-ordinated Crop-weather Scheme. In this paper the author has treated the replication in space as the replication in time with certain reservations. With the accumulation of more data the author could attempt in this paper a more valid statistical analysis.

2. Material and methods

Since the end product, namely the yield, may be considered as the integrated effect of the sequence of crop development from sowing to harvest, such as germination, tillering, elongation and ear-emergence, these crop features have been recorded systematically on wheat at Jalgaon and Niphad by resorting to sampling technique reported by Ramdas (1960). The agronomic practices followed in growing N.P. 4 variety of wheat in the relatively heavier black soil of Jalgaon with higher moisture holding capacity is somewhat different from those of Niphad. Thus at Jalgaon the seed rate is 60 lb/acre sown with seed drills in rows 13″ apart while in Niphad it is only 40 lb/acre in rows 10″ apart. This works out to an average of 69 seeds at Jalgaon and 34 seeds in Niphad per sample of four-foot length of row.

The statistical analysis of the data was carried out by employing the well known methods of correlation, regression and partial regression (Snedecor 1946).

3. The crop attributes studied

Among the various crop attributes contributing to the final yield, some of the more important ones are : (a) germinated seedlings, (b) number of shoots when the crop has completed tillering, (c) height and (d) number of earheads. The year to year values of these four crop attributes for the period 1947 to 1968 (22 years) for Jalgaon and Niphad are graphically represented in Figs. 1 and 2. From an examination of these two figures, the following broad inferences may be drawn.

3.1. Number of germinated seedlings per sample is of the order of 36 in Jalgaon while the corresponding value in Niphad is only 25.

3.2. In general there is much less tillering in Jalgaon than in Niphad. This may be ascribed to high seed rate and wider spacing of rows in Jalgaon, resulting in greater density of germinated inland on 7th the depression yielded higher rainfall volume of 9.97 million cm-hectares on 8 December. Thus the total water potential yielded by this system is 18.60 million cm-hectares. The normal monthly (December) rainfall volume for the correspondng areas covered by the isohyetal pattern (upto zero isohyet) of 7 December 1952 storm comes out to be 12.90 million cm-hectares. Thus the contribution to the water potential in 1-day is about 66 per cent of the monthly value.

3.4. From the foregoing discussions it is seen that 1-day contribution of storm rainfall volume as a percentage of the corresponding monthly normal rainfall volume for the same area as that of the storm is 12 per cent for October storm, 22 per cent for November storm and 66 per cent for the December storm. This shows that although the occurrence of storms in October and November months is relatively more frequent with higher contribution to water potential, the contribution of the less frequent December storms is more significant for the southern parts of Tamil Nadu and adjoining areas.

4. General conclusions

(*i*) The severity of cyclonic storms which form in the Bay of Bengal to the east of 82°E has no marked effect on the intensity and extent of the rainfall distribution.

(*ii*) Storms when moved to the west of Long. 80°E also contribute heavy rainfall in smaller areas over south Peninsula, but the total volume of the rainfall realised is about 10 per cent of the total rainfall volume realised when the storms are located inside the grid.

(*iii*) Systems forming south of Lat. 10°N do not contribute substantially to the water potential in the months of October and November whereas these sytems become important in the month of December.

(*iv*) Fast moving systems during the post monsoon months contribute less water potential compared to slow moving systems in the same period.

(*v*) Major contribution to water potential comes from the coastal areas of Tamil Nadu and Andhra Pradesh where the rainfall intensity is generally higher but the contribution from the low value isohyets extending over larger areas is equally significant.

(*vi*) Although these cyclones cause a lot of devastation to coastal areas their role in contributing water potential inland is vital.

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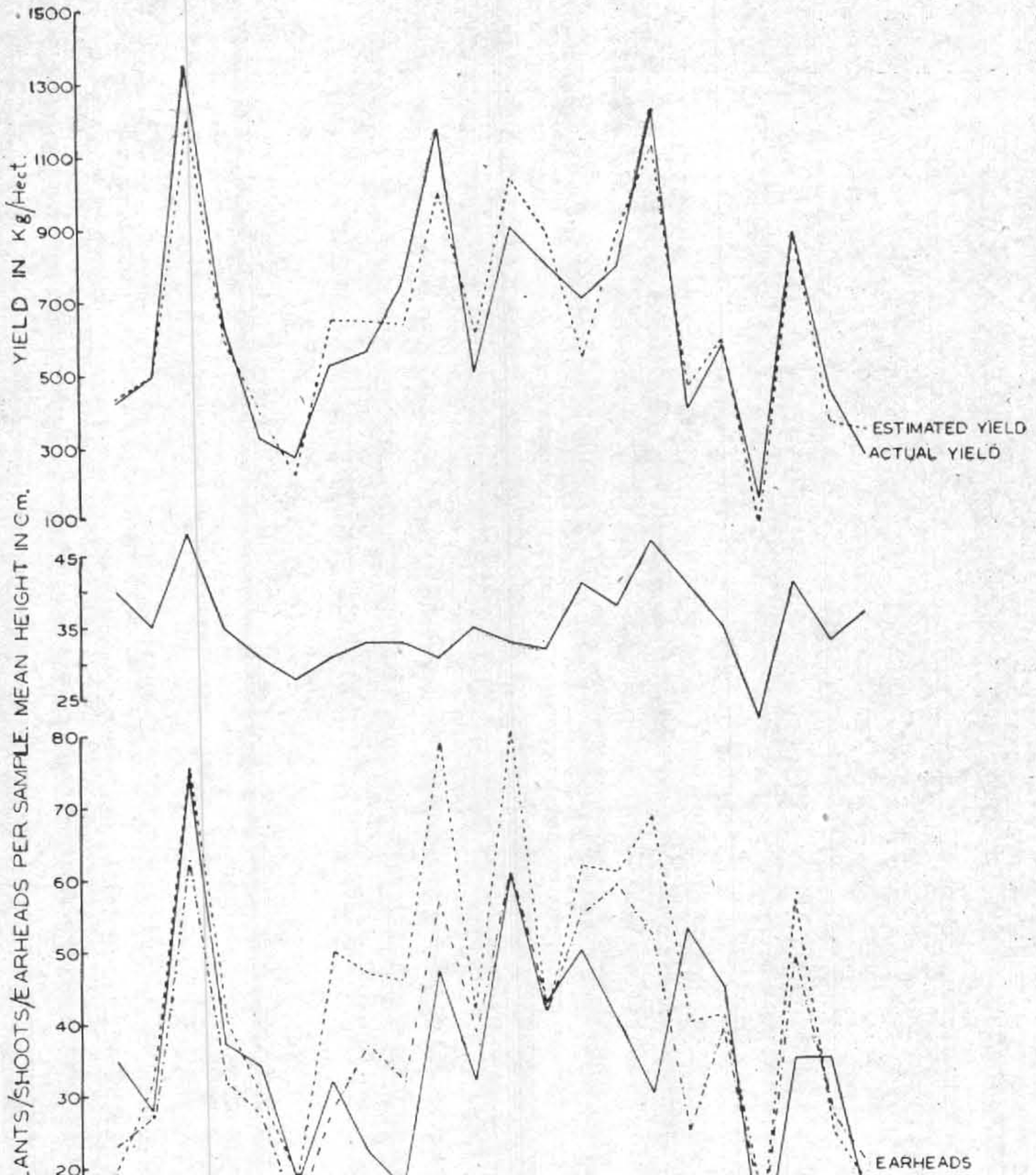

Fig. 1. Wheat at Jalgaon—Crop attributes and yield

TABLE 1

Simple correlation coefficients and regression equations

	C.C. between			
	Plant	Shoot	Height	Earhead
Correlation coefficients				
JALGAON				
Shoot	0·68**			
Height	0·43*	0·48*		
Earhead	0·71**	0·93**	0·60**	
Grain	0·62**	0·89**	0·65**	0·88**
NIPHAD				
Shoot	0·59**			
Height	0·03	0·30		
Earhead	0·65**	0·75**	0·46*	
Grain	0·56**	0·54**	0·59**	0·72**
Regression equation components on yield				
JALGAON				
Constant *c*	203·2	13·9	—556·6	—37·8
Regression *b*	12·54	14·21	34·67	18·45
Standard error of *b*	3·51	1·58	9·08	2·19
NIPHAD				
Constant *c*	97·2	157·0	—283·0	66·5
Regression *b*	15·55	6·53	23·05	16·89
Standard error of *b*	5·17	2·26	7·12	3·61

* Significant at 5 per cent level

** Significant at 1 per cent level

seedling per unit length of row with limited scope for tillering. The average number of shoots per sample is 45 for Jalgaon and 49 for Niphad.

3.3. Although tillering was profuse in Niphad, the number of earheads is reflected by the number of germinated seedlings rather than by the number of shoots. The reason for this is due to high mortality or poor growth of tillers in the comparatively poorer soil of Niphad with less moisture holding capacity. The average number of earheads per sample works out 37 in Jalgaon and 24 in Niphad.

3.4. In certain years with greater shoot development, the height curve for Jalgaon shows greater value. The degree of relationship between different crop attributes is discussed in the next section.

4. Simple correlation and regression studies of crop attributes and yield

The simple correlations between the four crop attributes reported already and the final yield of grain are given in the Table 1. In the same table the regression equations of each one of these crop attributes on yield are also worked out for both the stations.

Some of the important inferences are :

4.1. Of all the crop attributes, the height has the least relation with the other attributes especially in the wheat grown at Niphad.

4.2. Number of earheads shows the maximum relation with the other crop attributes. This relationship is more profound at Jalgaon.

4.3. At Jalgaon, the grain yield shows a strong affinity to number of shoots while at Niphad, all the three crop attributes, namely number of plant, shoot and height have more or less equal influence on yield.

4.4. The regression *b* of shoots on yield at Jalgaon is more than double the value for wheat at Niphad. The regression of height also indicates more profound influence at Jalgaon than at Niphad.

5. Partial regression and multiple correlation

Table 2 gives the partial regressions on yield of successive crop attributes commencing with germination. The table also gives the standard error of partial regression coefficients, the multiple correlations, mean values of the crop attributes and their standard deviations.

5.1. For Jalgaon the density of population especially after tillering accounts for nearly 80 per cent of the total variation in yield. This is not so in the higher soil of Niphad where it accounts for less than 30 per cent.

5.2. In Niphad the elongation in height which may be considered as the index of growth, gives a better estimate of grain yield, the M.C.C. being 0.800 (*i.e.*, 64 per cent of the total variation).

5.3. At both the stations, number of earheads which is again a function of density of population and better growth, does not help in improving the estimation of the yield.

These inferences are also brought out by Figs. 1 and 2 which give the actual and estimated yield values along with the four crop attributes taken into consideration in this study with a period of 22 years.

6. Discussions and suggestions

The above study has significantly brought out the differential behaviour of even the same variety of wheat (N.P. 4) grown at these two stations

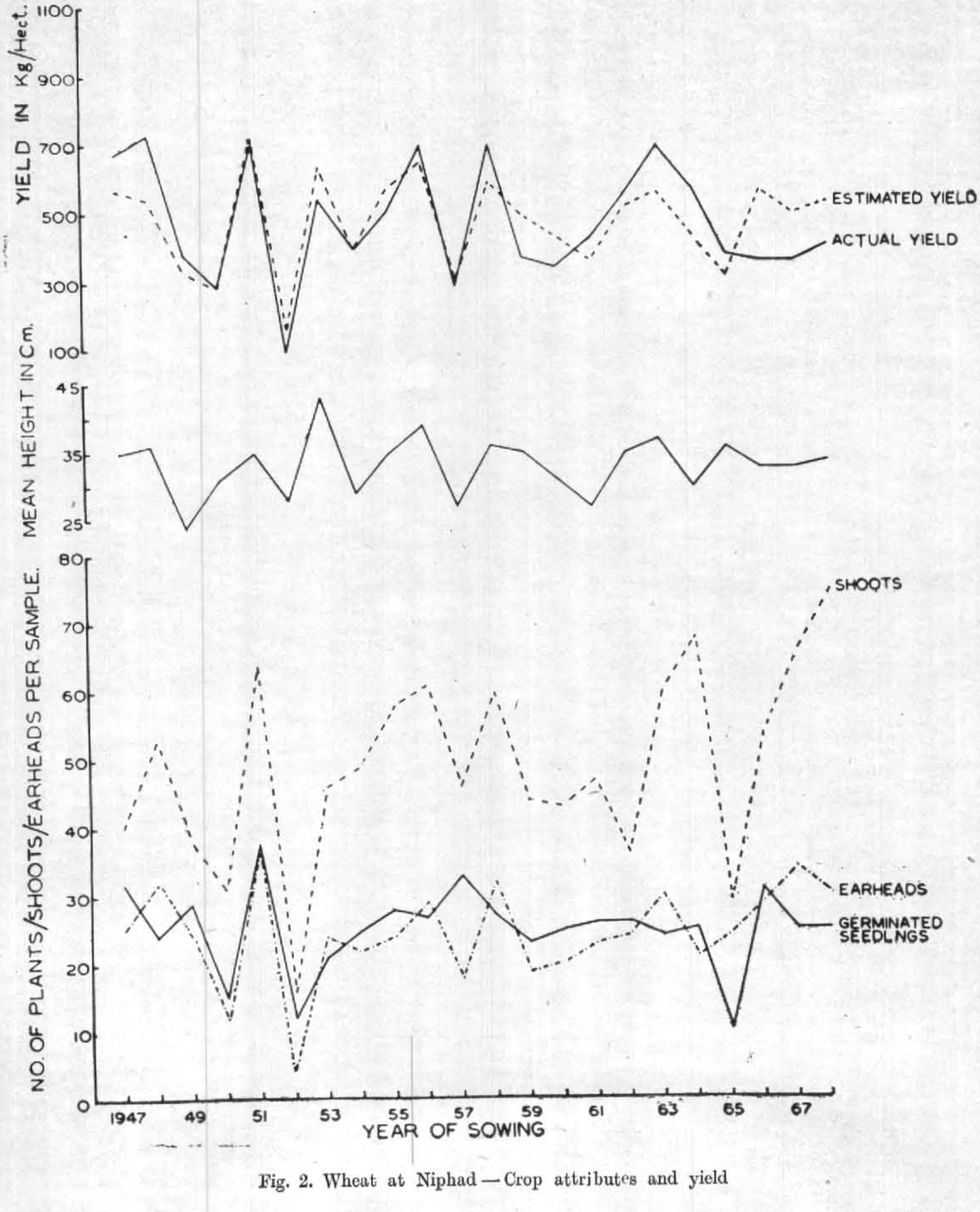

Fig. 2. Wheat at Niphad — Crop attributes and yield

TABLE 2

Regression of crop attributes on yield and the multiple correlation

Age of Crop (week)	Regression equation	M.C.C.
	JALGAON	
2	203·2 + 12·54**p (3·51)	0·623**
8	6·5 + 0·63p + 13·88**s (2·80) (2·21)	0·895**
10	—422·9 — 0·48p + 12·27**s + 15·53**H (2·40) (1·95) (5·34)	0·930**
14	—414·2 — 0·57p + 11·71*s + 15·08*H + 0·95E (2·54) (4·18) (6·23) (6·21)	0·930**
	NIPHAD	
2	97·2 + 15·55**p (5·17)	0·577**
8	35·0 + 10·18p + 3·39s (6·24)	0·616*
10	—315·8 + 13·55*p + 1·13s + 21·38**H (4·97) (2·25) (5·93)	0·800**
14	—502·8 + 10·17p — 0·42s + 17·48*H + 7·17E (5·72) (2·60) (6·77) (6·18)	0·816**

M.C.C.= Multiple correlation coefficient p= No. of germinated plants/sample
s= No. of shoots/sample H= Mean height (cm) of crop E= No. of earheads/sample
*= Significant at 5 per cent level **= Significant at 1 per cent level
Note — Values within brackets are the standard errors of the partial regression coefficients

not very far apart but with somewhat different type of black soil. Quantitative observations indicate that due to moisture stress during the later stages of crop at Niphad, the effect of the phenomenon of profuse tillering to compensate the lower number of seeds sown per row length has been nullified. This clearly demonstrates the danger of pooling the short period data for the homo-climatic zone treating replication in space as replication in time (Sreenivasan 1958). In the case of Niphad with less moisture holding capacity only the germinated seedlings are able to establish themselves successfully and not the tillers. Therefore it is highly reasonable to suggest for Niphad a much higher seed rate with greater distance between rows. Also at Niphad triple dwarf wheat with shorter duration should be cultivated.

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