The Pharma Innovation Journal 2022; 11(11): 1556-1559

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(11): 1556-1559

www.thepharmajournal.com
Received: 20-09-2022
Accepted: 25-10-2022

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Influence of weather parameters on yield of Dolichos bean (*Lablab purpureus* L.)

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Abstract
Dolichos bean (*Lablab purpureus* L.) is an important leguminous vegetable crop grown in almost all parts of the country. Green seed yield of the crop is influenced by number of yield contributing characters such as, green pod yield, pods per plant, days to 50 percent flowering, number of primary branches, raceme per plant, nodes per raceme, raceme length and 100 fresh seed weight. The effect of weather and rainfall particularly on crop yield depends on the distribution of rainfall during different phases of crop production. It is very rare that one weather factor accounts for all the variations in a crop's output. Thus multiple linear regression modelling for crop-weather models is commonly used. The predictability of such models improves with an increase in the number of explanatory variables. Crop yield-Weather relations is usually constructed by taking yield as the dependent variable and climate as the independent variables. Regression analysis using stepwise regression has revealed that the weather parameters are having both positive and negative impact on the green seed yield and other morphological traits. Minimum temperature, Sunshine hours and Rainfall were having significant effects on all the four characters taken into consideration. Whereas, other weather constraints like Relative humidity (afternoon) and Maximum temperature were affecting Number of primary branches and Pods per plant respectively.

Keywords: Dolichos bean, multiple linear regression, step-wise regression, model adequacy checking

Introduction
Dolichos Bean (*Lablab purpureus* L.) is a species of bean in the family Fabaceae. The plant is variable due to extensive breeding in cultivation. It is a multi-purpose crop cultivated for pulse, vegetables and forage. The crop is cultivated for its green pods, and its dry seeds are used in various preparations of vegetable food. It is considered to be a key protein sources in the diets in southern Indian states. Lablab as a field crop was essentially confined to the peninsular region and cultivated in Karnataka and neighboring states viz., Tamil Nadu, Andhra Pradesh and Maharashtra to a large extent. Karnataka contributes a significant share, accounting for nearly 90 percent both in terms of region and country growth. Indian farming is best example for rainfed farming, which comprises of both dry farming and dry land farming. Rainfed agriculture occupies about 51 percent of country's net sown area and accounts for nearly 40 percent of the total food production. Rainfed agriculture is heavily dependent on weather parameters.

Improvement in agriculture is highly climate-dependent and is also adversely affected by that climatic variability. Climate change is one of humanity's most important global environmental challenges with consequences for food production, natural ecosystems, freshwater supplies, health, and so on. The environment directly affects the crop's structural characteristic that is, it can encourage the development of diseases, pests, parasites and weeds, in this these factors may have influence on the yield. The effect of weather condition and rainfall particularly on crop yield depends on the distribution of rainfall during different phases of crop production. It is very rare that one weather factor accounts for all the variations in a crop's output. Thus multiple linear regression modeling for crop-weather models is commonly used. The predictability of such models improves with an increase in the number of explanatory variables.

Methods
The study was conducted in GKVK which is situated in Bengaluru, North Taluk of Bengaluru Urban District. It is a located in the Eastern Dry Zone (Zone-V). The Eastern Dry Zone includes Kolar, Tumakuru, Urban and Rural districts of Bengaluru, Chikkaballapur and Ramanagara.

The data on yield of Dolichos crop has been collected from the department of Genetics and Plant breeding while the weather data that is Temperature (Min. and Max. in °C), Relative Humidity (RH I and RH II in percent), Rainfall (in mm.) and Bright Sunshine Hours (hrs. /day) during the *Kharif* seasons of 2013, 2014 and 2015 were collected from the AICRP on Agro meteorology UAS, GKVK, Bengaluru-65.

Materials and Methods

The Descriptive Statistics such as minimum, maximum, mean, standard deviation, variance, skewness, kurtosis and coefficient of variation (CV) were calculated for the green seed yield and weather parameters. The influence of weather parameters on the crop yield and the component traits was assessed by relating crop yield and the traits with the weather parameters through linear functional forms. Multiple Linear Regression is a statistical technique that uses multiple explanatory variables to predict the outcome of a response variable. The objective of multi-linear regression (MLR) is to model the linear relation between explanatory (independent) and response variables (dependent).

The multiple linear regression model for the crop yield (Y) and the weather parameters (Xi) is given as,

$$Y' = X\beta' + \varepsilon$$

Where,

Y' = (Y_1 Y_2… Y_n) is the vector of values of the dependent variable thatis yield of Dolichos bean.

X is the matrix of order (n x p) containing the independent variables, weather parameters.

$\beta' = (\beta_1, \beta_2 \ldots \beta k)$ is the vector of parameters and $\varepsilon' = (\varepsilon_1, \varepsilon_2 \ldots \varepsilon_k)$is the error vector. The error vector ε is assumed to be normally distributed with N [0, σ^2]. The least square estimator of the parameter vector β is

$\hat{\beta}$ = b = $(X'X)^{-1} X'Y$

Its sampling variance is V (b) = $(X'X)^{-1} \sigma^2$

Thefitted equation is $\hat{Y}$ = Xb

In this study, y is the green seed yield and its component traits (number of primary branches, nodes per raceme and pods per plant), x_i's are the independent variables that is, daily weather parameters *viz*., maximum and minimum temperature, relative humidity (morning and afternoon), sunshine hours and rainfall. The significance of the model is tested by F-test.

Step-wise regression

Stepwise regression was one of the most regularly used algorithms for variable selection and it was given by Efroymson. This method was an improvement over the forward selection and backward elimination. In this method, all the regress or variables entered into the model previously were re-verified at each stage by using their partial F-statistics. The elimination of the variable from the model was done when the partial F- statistics value was less than the F_{OUT}.

Model adequacy checking

Adequacy of a model depends on the validity of assumptions underlying the model. Gross violations of the assumptions may yield an unstable model in the sense that a different sample could lead to a totally different model with opposite conclusions. We cannot detect departures from the underlying assumption by examination of the summary statistics such as t or F statistic or R^2. These are Global model properties and as such they do not ensure model adequacy. Hence, diagnostic methods, primarily based on the study of the model residuals are used. The diagnostics checks for the present study used are for randomness and normality of residuals.

An important assumption of multiple regression models is that the residual, ε follows normal distribution. This assumption is required to test the hypothesis about the regression coefficients. This assumption is verified by using, Randomness of error terms that is by employing one sample run test.

Multiple coefficient of determination (R^2)

Multiple coefficient of determination (R^2) was used to assess the adequacy of the model, which was used to know the percentage contribution of the independent variable on the dependent variable. The quantity is defined as follows,

$$R^2 = \frac{SS_R}{SS_T}$$

Where,

SS_R = sum of squares due to regression and SS_T = Total sum of squares.

Test of significance of the R^2 was done by employing the F test.

Result and Discussion

Mean and standard deviation values for number of primary branches was found to be 4.484 and 0.903 respectively. The curve for the trait was observed to be positively skewed (0.520). Pods per plant count data was positively skewed (0.306) with a mean and standard deviation of 23.223 and 7.384 respectively. The mean and standard deviation for green pod yield was 67.325 kg and 38.093 kg respectively. The computed mean and standard deviation for green seed yield data set was 67.325 kg and 21.831 kg respectively. It was found that both green pod yield and green seed yield data set was positively skewed.

It was observed that minimum temperature had a mean value of 19.35 °C whereas standard deviation was found to be 0.898 °C. The coefficient of variation was found to be 5.345 percent and nature of the curve was negatively skewed. The mean of the maximum temperature was found to be 28.56 °C and standard deviation was 1.526 °C. It had a coefficient of variation of 4.64 percent and the skewness was observed to be negative. Relative humidity (morning) had a mean value of 92.21 percent and standard deviation was observed to be 3.51 percent. The coefficient of variation of the relative humidity was observed to be 3.81 percent and it was negatively skewed. The mean value of Relative humidity (afternoon) was found to be 54.08 percent while the standard deviation was 5.89 percent. It had coefficient of variation value of 10.898 percent and skewness was found to be positive. It was observed that mean value of the bright sunshine hours was 4.81 hrs/day while it had a standard deviation of 3.174 hrs/day. The coefficient of variation was observed to be 65.96 percent and it was negatively skewed. Rainfall had a mean value of 5.373 cm. whereas the standard deviation was observed to be 13.64 cm. The coefficient of variation was observed to be 253.96 percent and Rainfall was positively skewed.

Table 1: Summary of statistics for green seed yield and its component traits (2013-15)

SL. No.	Parameters	Mean	Standard Deviation	Skewness	Minimum	Maximum	CV (%)
1	No. of primary branches	4.484	0.903	0.520	2.000	8.000	20.150
2	Pods/plant	23.223	7.384	0.306	7.000	44.000	31.796
3	Green pod yield (kg.)	121.080	38.093	0.696	31.371	248.349	31.461
4	Green seed yield (kg.)	67.325	21.831	0.694	21.911	136.710	32.426

Table 2: Summary of statistics for weather parameters (2013-15)

SL. No.	Parameters	Mean	Standard Deviation	Skewness	Minimum	Maximum	CV (%)
1	Minimum temperature (°C)	19.353	0.898	-1.004	15.4	21.8	4.641
2	Maximum temperature (°C)	28.564	1.526	-0.420	24	31.8	5.342
3	Relative humidity I (%)	92.219	3.514	-0.484	82	98	3.810
4	Relative humidity II (%)	54.086	5.894	0.978	40	77	10.898
5	Bright sunshine hours	4.8124	3.174	0.069	0	10.8	65.961
6	Rainfall (mm.)	5.3734	13.646	3.978	0	100.8	253.973

Table 3 shows the outcome of the multiple linear regression with morphological characters as dependent variables and the weather parameters as the independent variables. For the trait primary branches relative humidity (afternoon) had negative influence whereas minimum temperature, bright sunshine hours and rainfall showed positive impact. Santhosh Kumara (2015) [1] in his study has shown that rainfall and relative humidity were having significant positive effect on the number of primary branches of dolichos bean. The model F ratio (130.582) was significant with R^2value of 0.935 i.e., nearly 94 percent of variation in number of primary branches was explained by the three weather parameters. For the second model with the dependent variable as pods per plant, Relative humidity (evening), minimum temperature and bright daylight hours had positive impact on pods per plant. The model F ratio (584.571) was significant with R^2 value of 0.919 i.e., nearly 92 percent of variation in number of primary branches was explained by these weather parameters. For the trait green pod yield, weather parameters *viz.*, minimum temperature, bright sunshine hours and rainfall had positive impact. The model F ratio (312.493) was significant with R^2 value of 0.929 i.e., nearly 92 percent of variation in this model was explained by three weather parameters *viz.*, minimum temperature, bright sunshine hours and rainfall. Similarly for the trait green seed yield the independent variables *viz.*, minimum temperature, bright hours of sunlight and rainfall had a positive effect. These three environmental parameters had significant impact on the green seed yield. Vishwambar, (2016) [2] has shown similar positive effect on the yield of Kharif tomato whereas morning humidity, evening humidity and rainfall were having negative effect on the yield on tomato crop. The model F ratio (1229.196) was significant with R^2 value of 0.887 *i.e,* nearly 89 percent of the variation in green seed yield was explained by the three environmental parameters. All these four models were free from Multicollinearity with all the Variance Inflation Factor (VIF) showing a value below 10.

Table 3: Results of step wise regression of morphological traits on weather parameters

Morphological Traits	Weather Parameters							
	Intercept	Min. Temp.	BSSH	RF	Max. Temp.	RH II	F	R^2
Primary branches	- 2.739^{NS}	0.482* (9.635)	0.103** (4.102)	0.029** (1.077)	-	- 0.014^{NS} (4.560)	130.582**	0.935
Pods per plant	-34.891*	3.056** (4.487)	1.027** (9.458)	0.336** (4.023)	-0.260* (1.108)	-	584.571**	0.919
Green pod yield	- 209.405*	14.912** (4.559)	7.593** (8.649)	1.922** (4.105)	-	-	312.493**	0.929
Green seed yield	-6.632^{NS}	2.500* (4.769)	6.738** (9.013)	0.663** (4.124)	-	-	1229.196**	0.887

NS - Non Significant *Significant at 5 % **Significant at 1 %
Values within the parenthesis indicates the Variance Inflation Factor value

Test for Randomness

The randomness of the errors was checked using runs test to check the adequacy of the model. The findings for randomness of errors was given in Table 4. It was observed from the study that for all four models, the error terms were distributed randomly with the total number of runs being equal to 32, 24, 22 and 23 for number of primary branches, pods per plant, green pod yield and green seed yield respectively.

Table 4: Results of run test for residuals of regression model

SL. No.	Parameters	Total cases	No. of runs	p-value
1	No. of primary branches	54	32	0.271
2	Pods/plant	54	24	0.271
3	Green pod yield (kg.)	54	22	0.099
4	Green seed yield (kg.)	54	23	0.169

Conclusion

Regression analysis using stepwise regression has revealed that the weather parameters were having both positive and negative impact on the grain yield and other morphological traits. Minimum temperature, sunshine hours and rainfall were having significant effects on all the four characters taken

into consideration. Whereas, other weather constraints like relative humidity (afternoon) and maximum temperature were affecting number of primary branches and pods per plant respectively.

Reference

1. Santhosha Kumara MA. Crop modelling on estimation of yield and yield related parameters in soybean. M. Sc. (Agri.) Thesis (Unpub.), Univ. Agric. Sci. Dharwad, Karnataka; c2015.
2. Vishwambar JA. Influence of weather parameters on tomato vegetable crop under Parbhani district. M. Sc. (Agri.) Thesis (Unpub.), Vasantrao Naik Marathwada Krishi Viyapeeth, Parbhani; c2016,
3. Sunil KM, Devadas VS, George Susamma. Influence of weather parameters on yield and yield attributes of areca nut (*Areca catechu* L.). J Agric. Physics. 2011;11:88-90.