Performance of Clusterbean (*Cyamopsis tetragonoloba L.*) Varieties under Different Temperature and Relative Humidity Profiles

ABSTRACT

A study was performed at Department of Plant Pathology during year 2020, CCS Haryana Agricultural University to find the effect of different growing environments on temperature and humidity profile development, yield and its attributes in clusterbean crop. Three varieties of clusterbean varieties *i.e.* HG 365 (V1), HG 563 (V2) and HG 2-20 (V3) with each sown at three different dates of sowing *i.e* first (D1), third (D2) and fourth (D4) week of July in factorial randomized block design and replicated thrice. The diurnal range of temperature profiles at the emergence stage and flowering stage were higher in the crop sown in the first fortnight of July as compared to the second and third fortnights of July. Crops sown in the fourth week of July had a greater diurnal range of relative humidity profiles at the vegetative and pod formation stage while at flowering stage higher diurnal variation were present in first week of July sown crop. However, among different cultivars of clusterbean, no variation in temperature and humidity profile were observed. Significantly higher number of branches per plant, number of pods per plant, pod length, number of seeds per pod, harvesting index, grain and straw yield were found in D1 (first week of July) and V2 (HG 563) as compared to remaining dates of sowing and varieties, respectively.

Keywords: Clusterbean; HG 365; HG 2-20; HG 563; yield; temperature and humidity profile.

1. INTRODUCTION

clusterbean (*Cyamopsis tetragonoloba* L.), a warm-season legume crop with a deep and well-developed root system, can withstand droughts and is typically grown as a rain-fed crop in arid and semi-arid regions [1]. It can withstand high salinity levels and needs 200 to 375 mm of rain per year along with lots of sunlight. For determinate types of guar, the growth season lasts 60–90 days, while for indeterminate varieties, it lasts 120–150 days [2]. Guar has long been used in cultivation as a crop for green manure, livestock feed, and vegetables. It needs fewer agronomic inputs and can be grown on poor and marginal lands. It is capable of symbiotic nitrogen fixing because it is a grain legume. As a result, it can enhance the soil's quality naturally and affordably, which will increase the yield of succeeding harvests (Thapa et al., 2015). In addition, guar gum is a molecularly heavy natural polysaccharide that readily hydrates in cold water to create a highly viscous dispersion or even gel at low concentrations. Due to the presence of glactomannan gum, guar is a significant commercial cash crop with more than 300 industrial uses [3]. The crop's fertilization, pod growth, and seed quality are all affected by high humidity and precipitation. (Reddy et al., 2016). High temperatures (36.1 °C) and lower relative humidity (78%) have been associated to increased seed output and gum content in the plant. [4]. The varieties and sowing time are two of these variables that are essential to the development and growth of the crop. Sowing time, among other crop production variables, has a significant impact on yield potential. According to Henry and Kackar (2001), guar genotypes greatly interacted with the environment to increase yield. Temperature had a direct impact on crop longevity as well as dry matter accumulation, leaf area development, and yield at the end. Rainfall, high relative humidity, and lower day temperatures promote proper seed setting at vegetative growth, flowering, and podding phases by promoting pollination and preventing pollen desiccation [5]. Meena [6] discovered that weather conditions (rainfall and temperature) had no significant impact/correlation on cluster bean types' production, characteristics, or growth. However, the present investigation results are different and was conducted to determine the best sowing time and variety of clusterbean, as well as to evaluate the performance of clusterbean (Cyamopsis tetragonoloba L.) varieties under various temperature and relative humidity profiles.

2. MATERIALS AND METHODS

During the *kharif* season 2020, a field trial was carried out at CCS Haryana Agricultural University, Hisar to examine the impact of various clusterbean varieties sown at different times on the temperature and humidity profiles development & yield and its attributes. Clusterbean varieties HG-365, HG-563, and HG-2-20 are used in the experiment along with three sowing days in the first, second, and fourth weeks of July under a factorial randomised block design. The crop husbandry practices were followed in accordance with the practises and recommendations of CCS HAU, Hisar.

Micrometeorological observations: Temperature and relative humidity profiles were measured using an Assmann Psychrometer at three levels of crop canopy: top, middle, and bottom, at different phenological stage viz. vegetative stage, flowering stage, pod formation following crop sowing.

The crop was planted by hand in the evening, with plant spacing of 10 cm and row spacing of 45 cm, irrigation was applied at 15 days intervals during the first stage of the crop, except when monsoon rains fell. Five plants were randomly selected from each plot and number of branches emerging from main stem was counted and average was taken as number of branches per plant. From these five plants number of pods and number of seeds per pod were also counted and average was taken. For counting the pod length, five pods were selected randomly and their length was measured, mean was taken as pod length (cm). A total number of 1000 seeds were counted from seed lot and their weight was measured. For recording the yield, crop was cut from net plot area, sun dried and weighing was done to calculate biological yield. After harvesting threshing was done, yield was recorded kg/plot and finally expressed as kg/ha after conversion. Harvesting index was calculated using the formula given below:

$$HI = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

The mean values of replicated observations were tabulated and statistically analyzed in the study using Statistical Software Package for Agricultural Research Workers by Department of Mathematics Statistics, CCS HAU, Hisar (Sheoran et al. 1998).

The F-test was used to measure the significance of the treatment effects at the 5% significance level. Cluster bean crop seed yield and attributes have been correlated with meteorological parameters such as temperature and relative humidity

3. RESULTS AND DISCUSSION

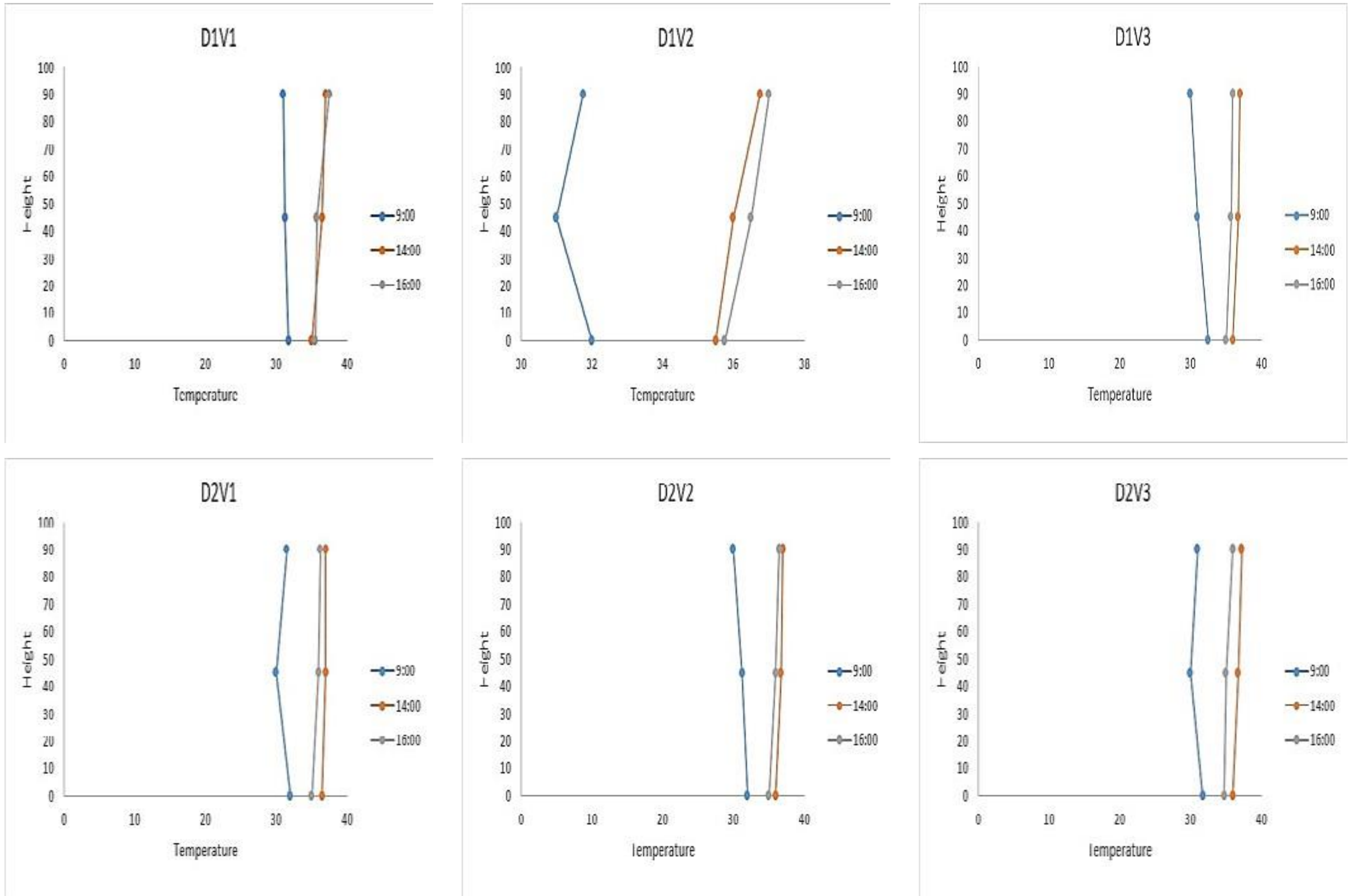
3.1 Temperature and Humidity Profile

In all three varieties and growing environments, the maximum temperature was recorded at 1400 hours, while the lowest temperature was recorded during crop season at 800 hours. Morning temperature profiles (08:00 hours) increasing with height inside the crop canopy, and evening temperature profiles (18:00 hours) were lapse in nature, decreasing with height inside the crop canopy; however, noontime profiles were nearly isothermal, meaning that the temperature remained the same with crop height inside the canopy. The diurnal range of temperature profiles at the emergence stage and flowering stage were higher in the crop sown in the first fortnight of July as compared to the second and third fortnights of July. No variation in diurnal temperature profile was observed among clusterbean varieties (Fig. 1, Fig. 2 and Fig 3.). This may be because, compared to morning and afternoon, the radiation enters the crop canopy more deeply at midday. Similarly findings were reported by Rajesh et al*.,* (2018) and Shamim et al. [7].

The relative humidity profiles in all of the treatments were lapse in character, meaning that the relative humidity decreased with crop height inside the crop canopy. But compared to other times of the day, the rate at which humidity decreased with height at 0900 was lower. When compared to crops sown in the first and second weeks of July, crops sown in the fourth week of July had a greater diurnal range of relative humidity profiles at the vegetative and pod formation stage however at flowering stage higher diurnal variation were present at first week of July sown crop. No diurnal variation in humidity profile was observed among different clusterbean cultivars. (Fig. 4., Fig. 5. And Fig. 6.). The crop canopy experienced more evapotranspiration and turbulence at midday compared to the morning and evening, which led to a greater exchange of water vapour with the canopy's upper air. Similar results was reported by Bose et al. [8].

3.2 Yield and its Attributes

The clusterbean variety HG 563 planted in the first week of July had significantly higher number of branches per plant, number of pods per plant, pod length, number of seeds per pod, harvesting index, grain and straw yield as compared to remaining date of sowing and varieties (Table 1.). The crop sown during the first week of July had higher radiation absorption and better energy efficiency than crops sown on other dates, which may have contributed to the higher yield and yield attributes that were found in this crop. The yield and yield attributes declined with delay in sowing and were higher in crops sown during this time. These results are in line with Ujjammanavar et al. [9]; Kumar et al. [10]; Kalyani et al., [11].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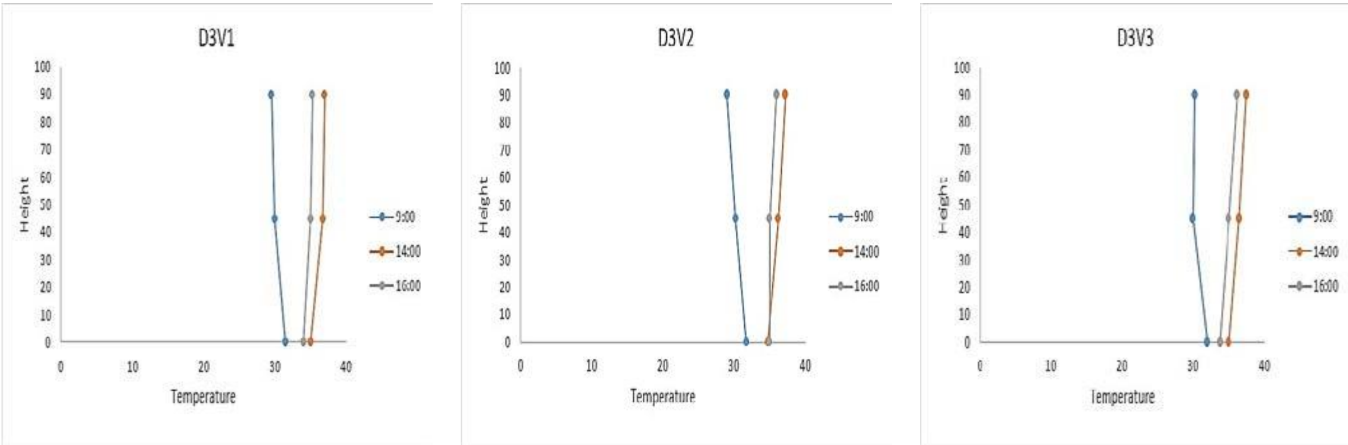
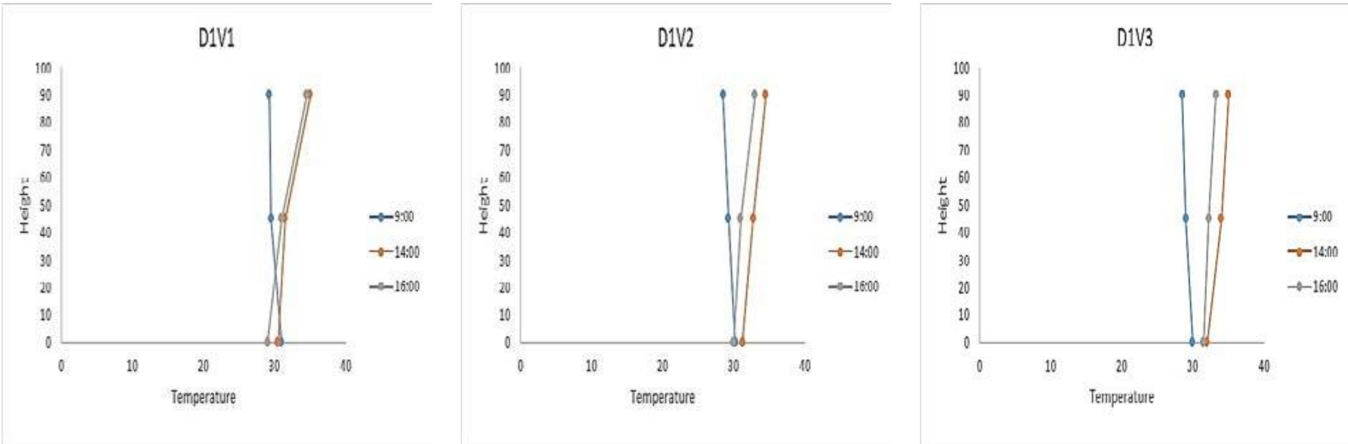


Fig. 1. Diurnal temperature profile in cluster bean crop at vegetative stage during different growing environments



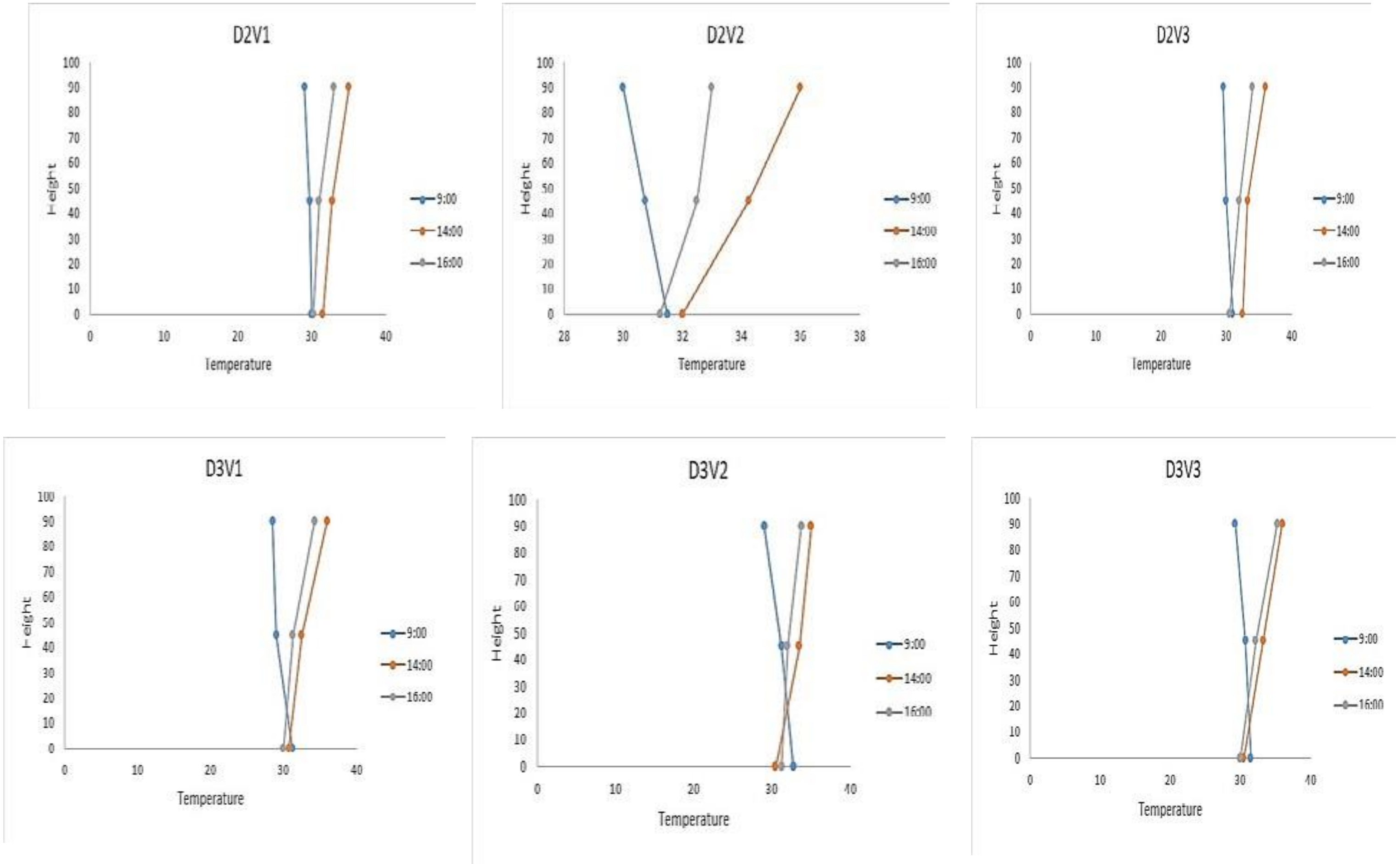
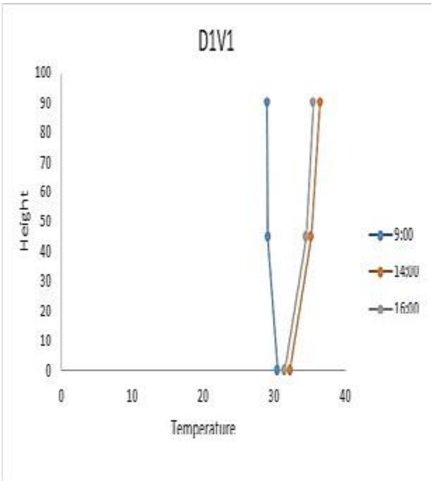


Fig. 2. Diurnal profiles of temperature in cluster bean crop at flowering stage during different growing environments.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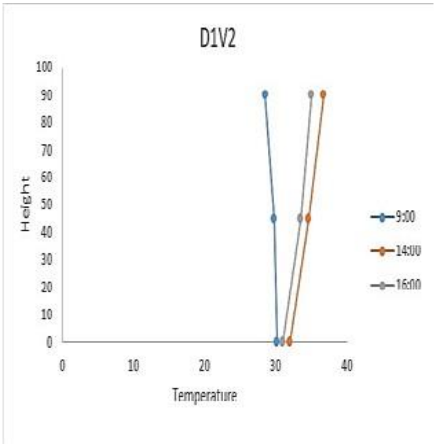
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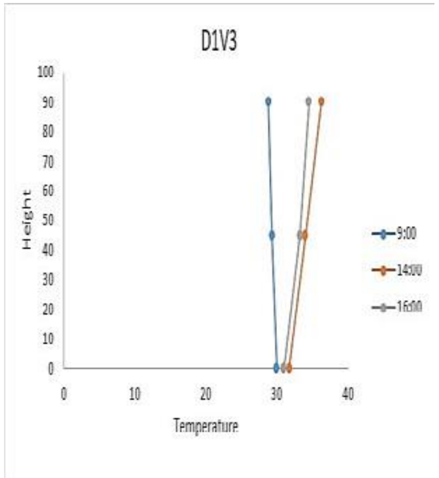
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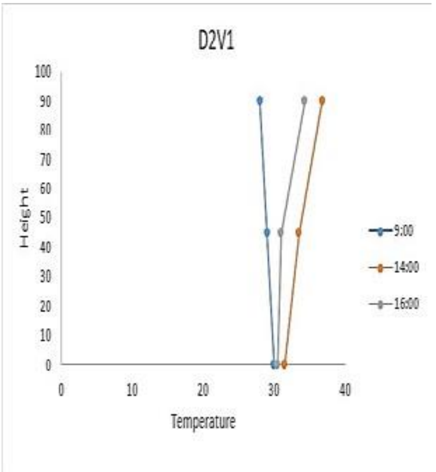
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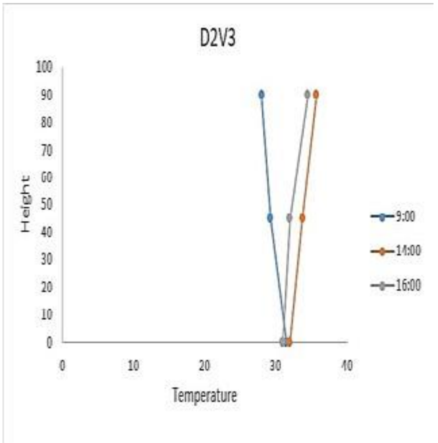
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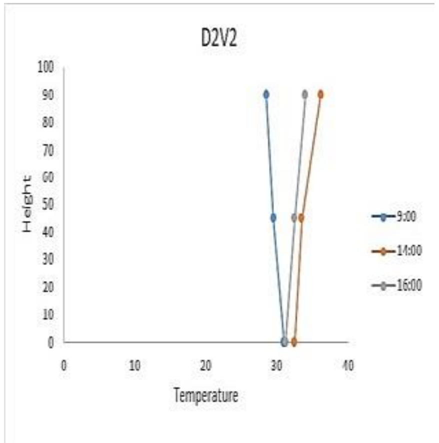
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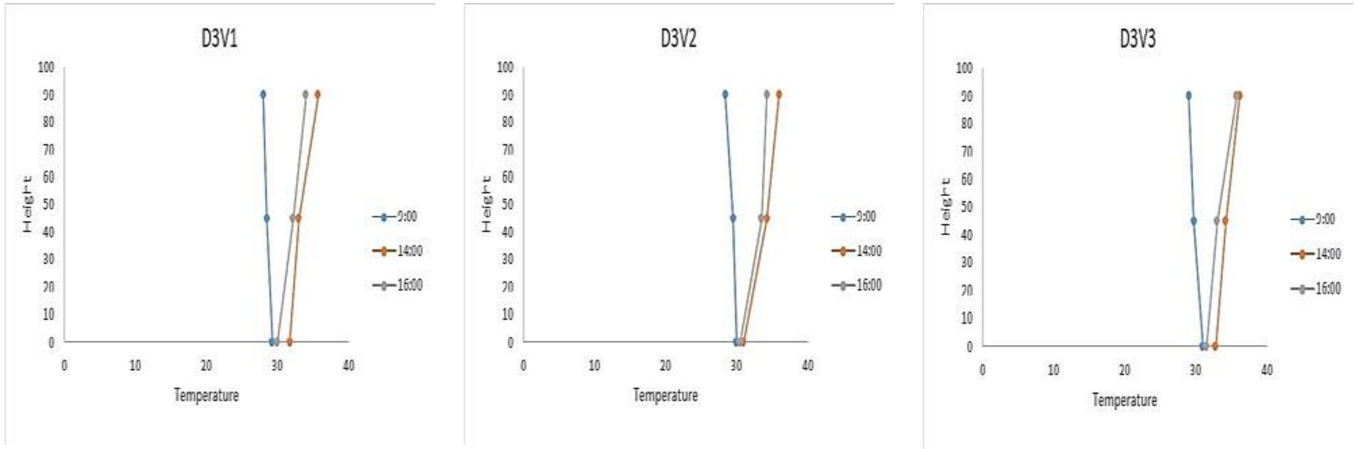
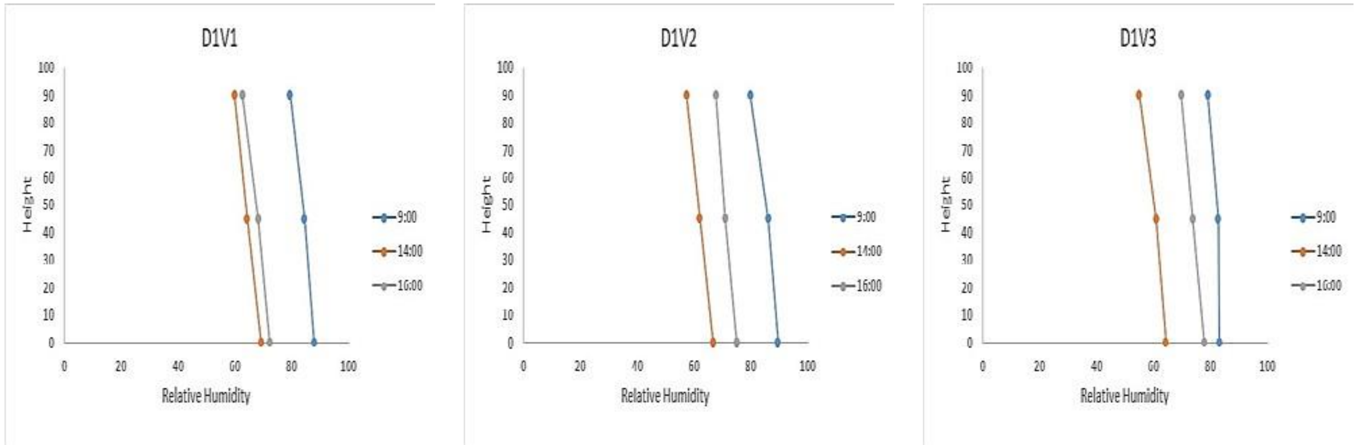


Fig. 3. Diurnal profiles of temperature in cluster bean crop at pod formation stage during different growing environments



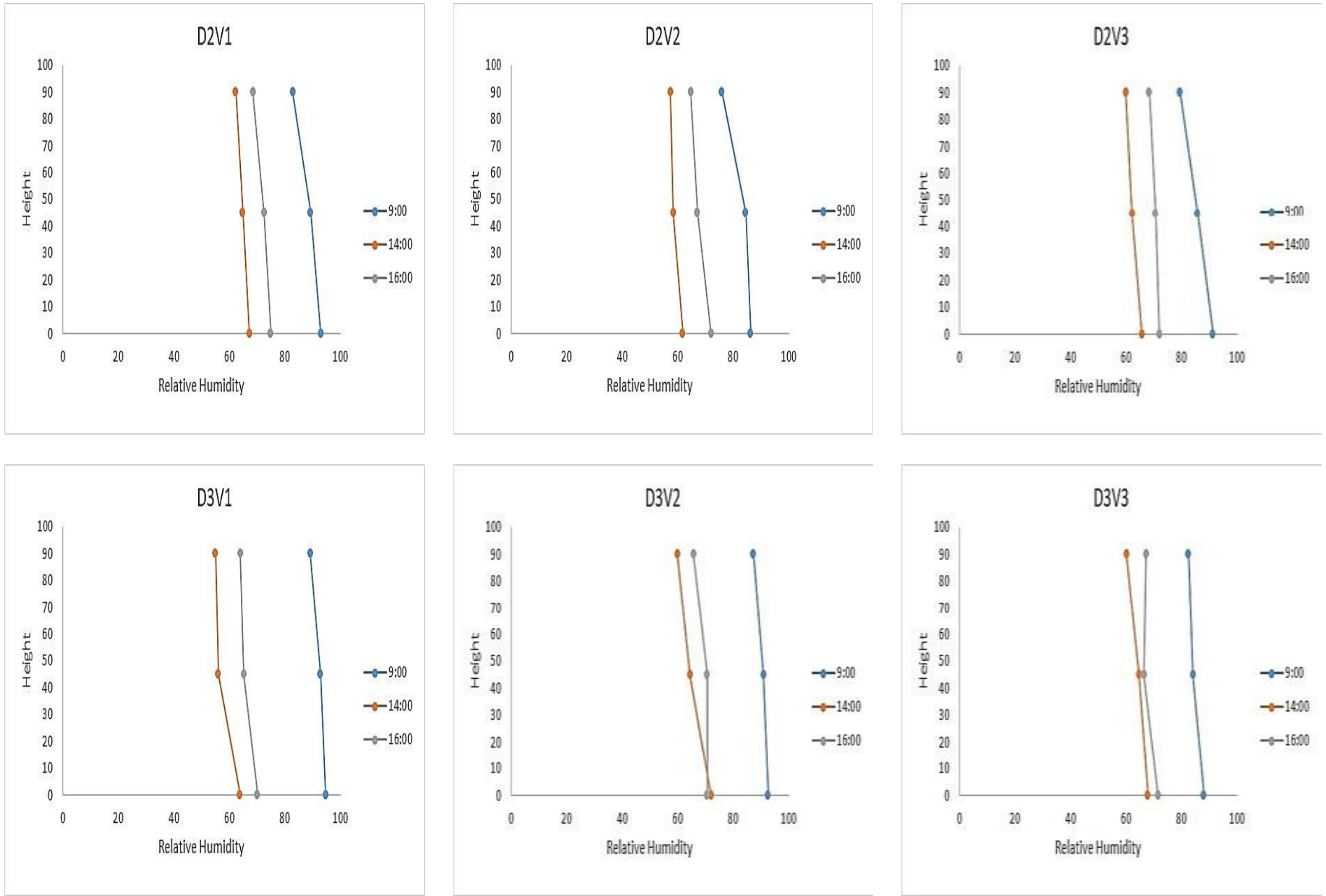
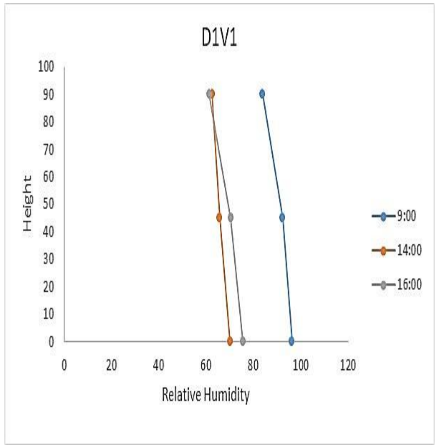


Fig. 4. Diurnal profiles of relative humidity in cluster bean crop at vegetative stage during different growing environment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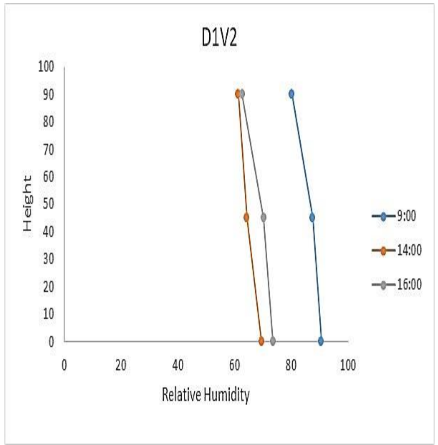
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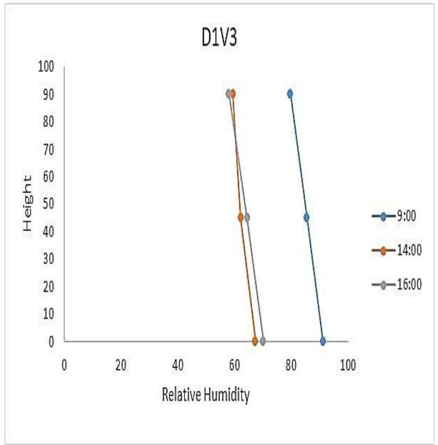
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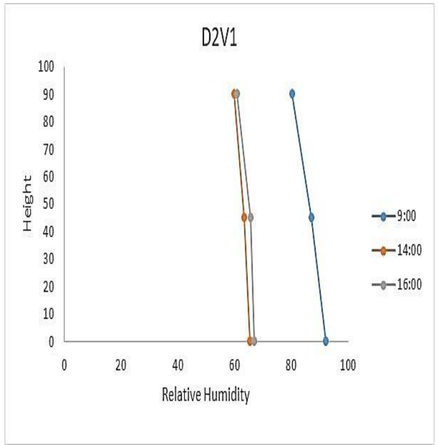
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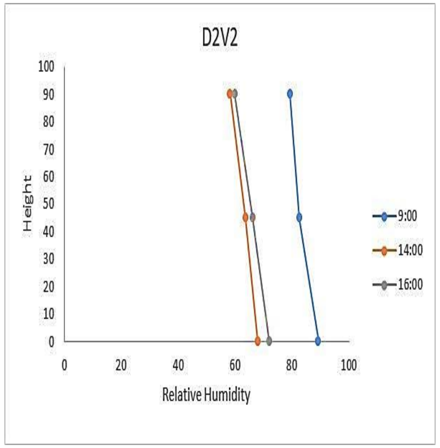
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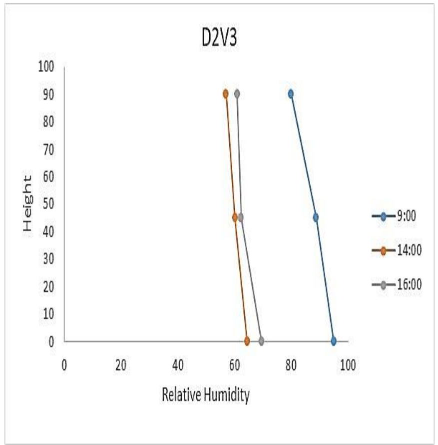
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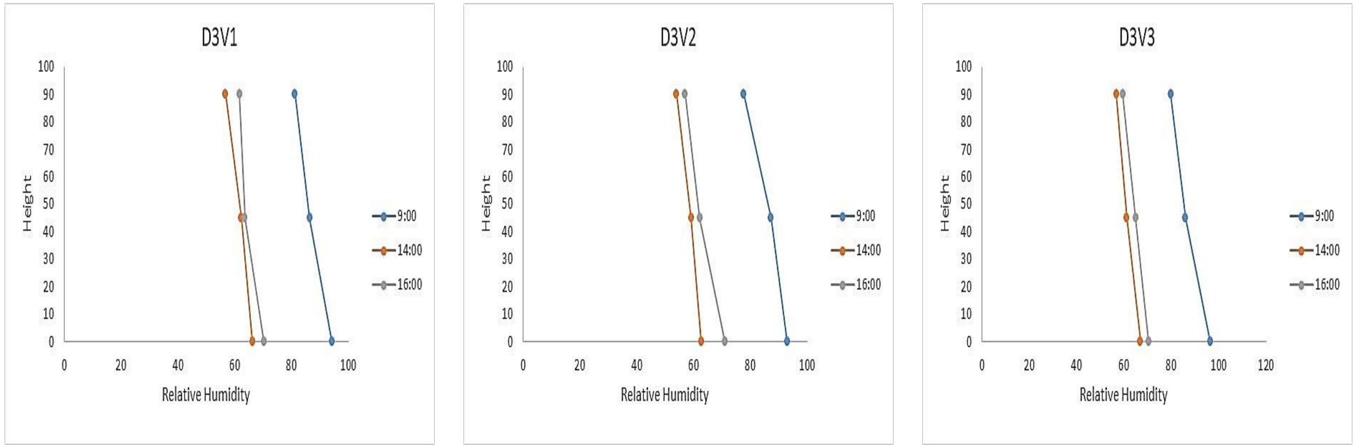
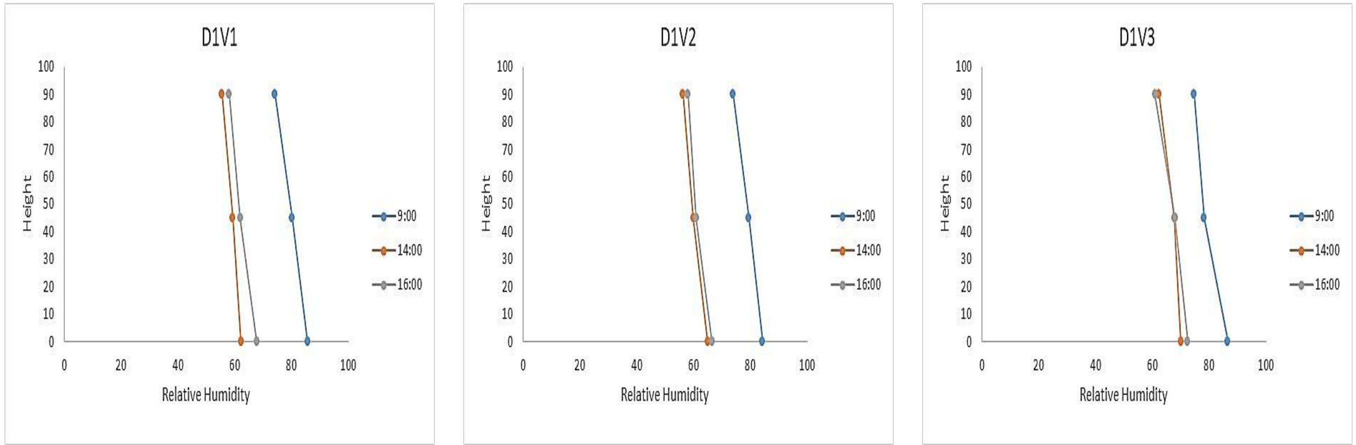


Fig. 5. Diurnal profiles of relative humidity in cluster bean crop at flowering stageduring different growing environments



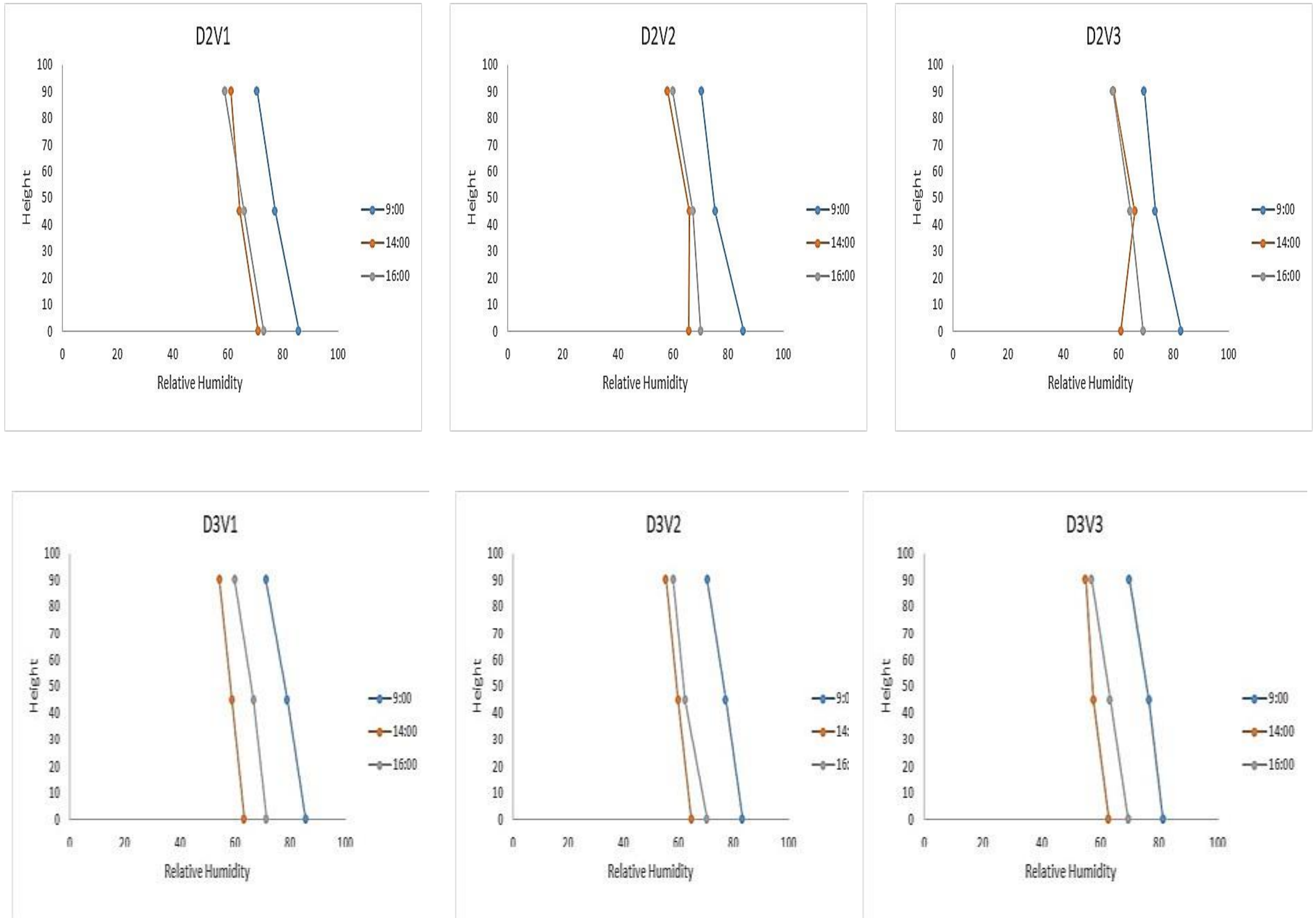


Fig. 6. Diurnal profiles of relative humidity in cluster bean crop at pod formation stageduring different growing environments

Table 1. Yield and its attribute as affected by different date of sowing and varieties

Treatments	Number of branches	Pods per plant	Pod length (cm)	Seedsper pod	Test weight (g)	Seed yield (kg/ha)	Stower yield (kg/ha)	Biological yield (kg/ha)	Harvest index(HI)
D1	12.8	42.7	6	5.37	26.08	1192.04	2406.58	3598.62	32.99
D2	12.3	39.5	5.5	5.36	25.81	957.47	2341.83	3299.31	28.90
D3	11.0	36.0	5.2	5.05	24.59	763.23	2259.25	3022.49	25.13
CD at 5%	1.41	1.73	0.47	0.125	0.59	84.46	60.14	110.69	1.67
V1	10.2	36.7	5.3	5.02	23.92	853.77	2238.41	3092.18	27.42
V2	13.3	43.0	5.8	5.56	27.07	1112.48	2464.19	3576.68	30.94
V3	12.6	38.6	5.5	5.21	25.50	946.50	2305.07	3251.57	28.65
CD at 5%	1.41	1.73	N/A	0.12	0.59	84.46	60.14	110.69	1.78

**Significant at 5% level of significance*

Table 2. Correlation of seed yield and Pods/plant with weather parameters of cluster bean cultivars

	V1 (HG 365)		V2 (HG 563)		V3 (HG 2-20)	
Treatments	Pods/plant	Seed yield (kg/ha)	Pods/plant	Seed yield (kg/ha)	Pods/plant	Seed yield (kg/ha)
T_{MAX} (˚C)	0.938*	0.820*	0.831*	0.886*	0.829*	0.880*
T_{MIN} (˚C)	-0.942*	-0.942*	-0.900*	-0.874*	-0.902*	-0.900*
RH % (M)	0.820*	0.942*	0.880*	0.904*	0.980*	0.884*
RH % (E)	-0.940*	-0.935*	-0.884*	-0.859*	-0.894*	-0.848*

3.3 Crop Weather Relationship

Weather conditions influenced seed output and pod count per plant in cluster bean crop cultivars evaluated.Test weight and seedsper pod were statistically unrelated to weather parameters and agrometeorological indicators since they are primarily determined by plant genetics. When the entire cluster bean data set was pooled and analyzed, we discovered that minimum temperature, as well as evening relative humidity, had a negative impact on cluster bean crop. This is easily understood as the impact of various climatic elements on cluster bean crop flowering, which influenced the number of pods per plant, which influenced overall seed yield. These findings are comparable to those obtained by Ramakrshna et al. [12] in the case of pigeon pea and Kumar [5] in the case of soyabean [13-15].

4. CONCLUSION

The diurnal range of temperature profiles at the emergence stage and flowering stage were higher in the crop sown in the first fortnight of July as compared to the second and third fortnights of July. No diurnal variation in humidity and temperature profile was observed among different clusterbean cultivars. Yield and its attributes were found maximum in variety HG 563 sown in first week of july. When whole of data of cluster bean was pooled and analysed, we see that cluster bean crop was negatively influenced by minimum temperature and evening relative humidity.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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