Original Research Article

Evaluation ofclusterbean (Cyamopsis tetragonoloba L.)Yield, Temperature and relative humidity profile under different growing environments

Abstract

A study was performed at Department of Plant Pathology, 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 clusterbeanvarieties *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 inD1 (first week of July)and V2(HG 563) as compared to remaining dates of sowing and varieties, respectively.

Keywords:Clusterbean, HG 563, temperature and humidity profile, yield

Introduction

Guar (*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 (Abbas *et al*., 2017). 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 (Singla *et al*., 2016). 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 (Liyanage *et al*., 2015). Climate (temperature, humidity, rainfall, etc.), sowing time, seed rate, variety, spacing, fertilizers, drainage, etc. all have an impact on how a crop develops (Reddy *et al*., 2016). 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.

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Clusterbean or Guar?

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The development of diseases like Alternaria blight's causal pathogen, *Alternaria cyamopsidis*, which affects the cluster bean crop indirectly, is also influenced by meteorological variables and weather parameters.

Material 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 barred design. The crop husbandry practices were followed in accordance with the practises and recommendations of CCS HAU, Hisar.

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:

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

Statistical analysis was done using OP STAT software of CCS HAU, Hisar.

Results and Discussion

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

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Comment [U8]: Dear authors,
It is necessary to include fertilization, seed density, information about the size of the plots (number of rows, row spacing, row length), how the sowing was carried out and the size of the useful area of the plot.

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I suggest describing which statistical analyses were performed. This is important so that readers can reproduce the experiment.

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Was this temperature obtained from a weather station or was it measured at each experimental unit?
If it was measured in each experimental unit, I suggest reporting the number of points at which the temperature was measured within the same plot.

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.*, (2008).

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.*, (2008).

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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.*, (2006), Kumar *et al.*,(2008) and Kalyani*etal.*,(2012).

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It is necessary to describe which statistical analyses were performed to infer the significance between the values.

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How was energy efficiency assessed? It needs to be described in the material and methods.

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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.

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

Treatments	Number of branches	Podsperplant	Podlength(cm)	Seedsperpod	Testweight(g)	Seedyield (kg/ha)	Stoweryield (kg/ha)	Biologicalyield (kg/ha)	Harvestindex(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
CDat 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
CDat 5%	1.41	1.73	N/A	0.12	0.59	84.46	60.14	110.69	1.78

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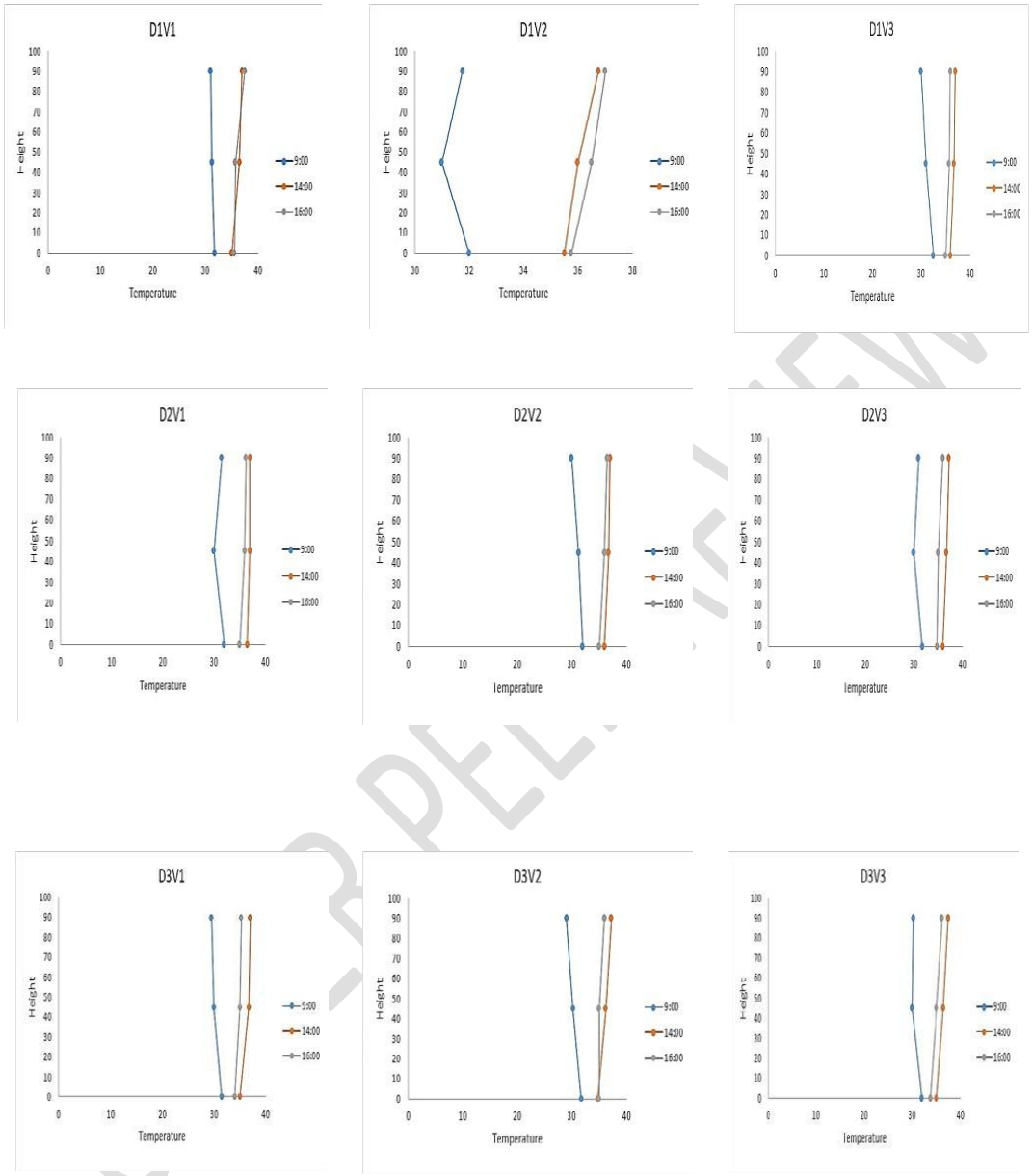

Fig.1: Diurnaltemperature profileinclusterbeancropatvegetativestageduring differentgrowing environments.

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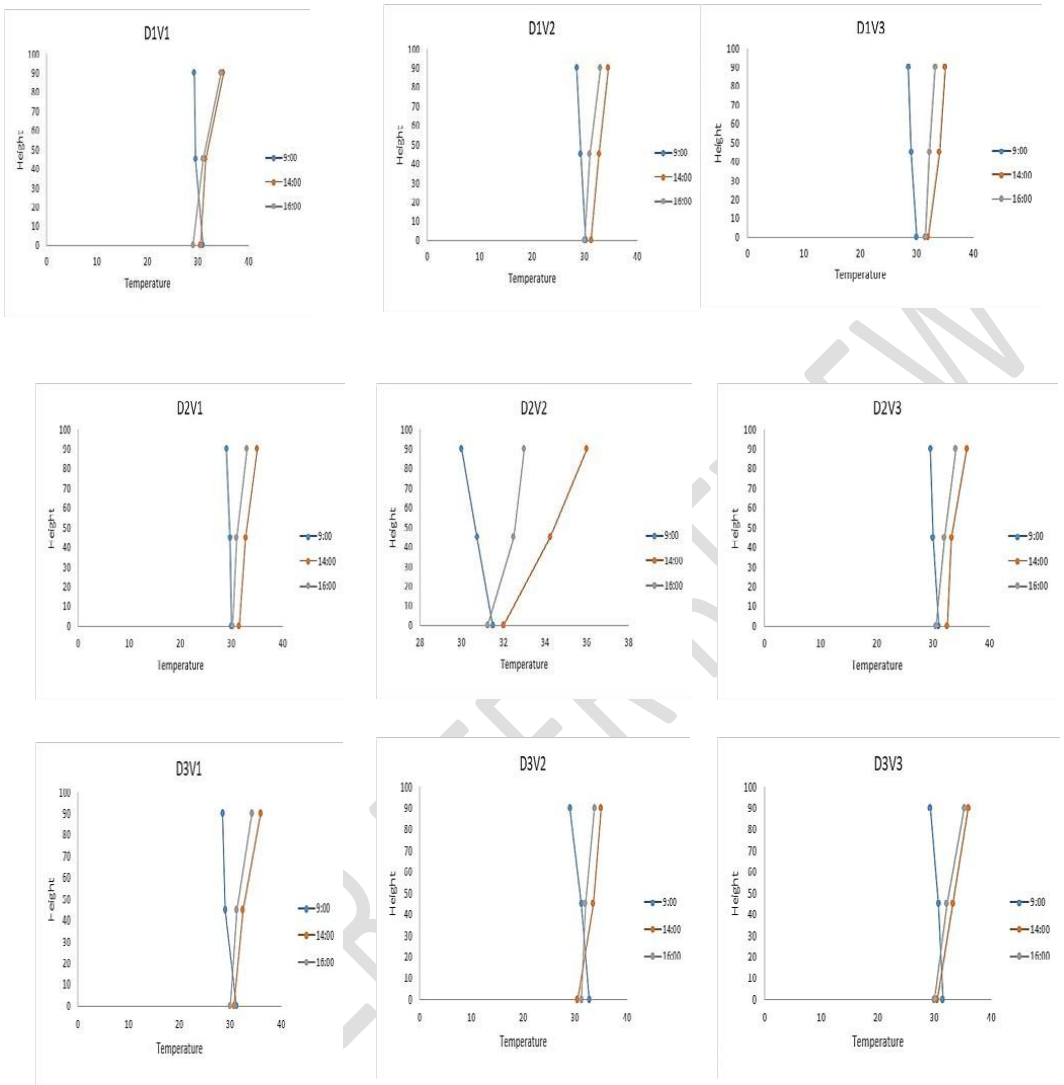


Fig.2:Diurnalprofilesoftemperatureinclusterbeancropatfloweringstageduringdifferentgrowing environments.

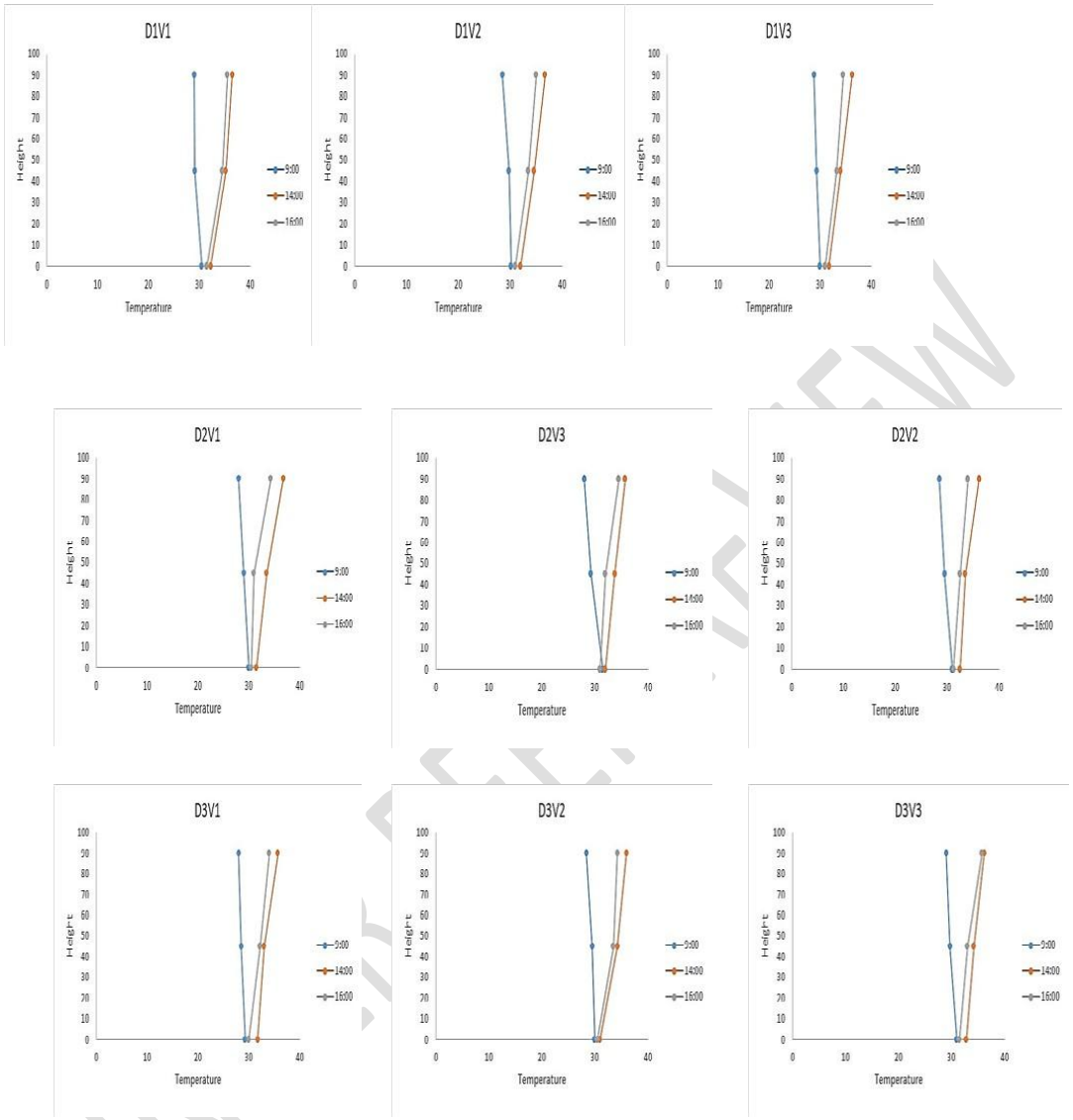


Fig.3:Diurnalprofilesoftemperatureinclusterbeancropatpodformationstage duringdifferentgrowing environments

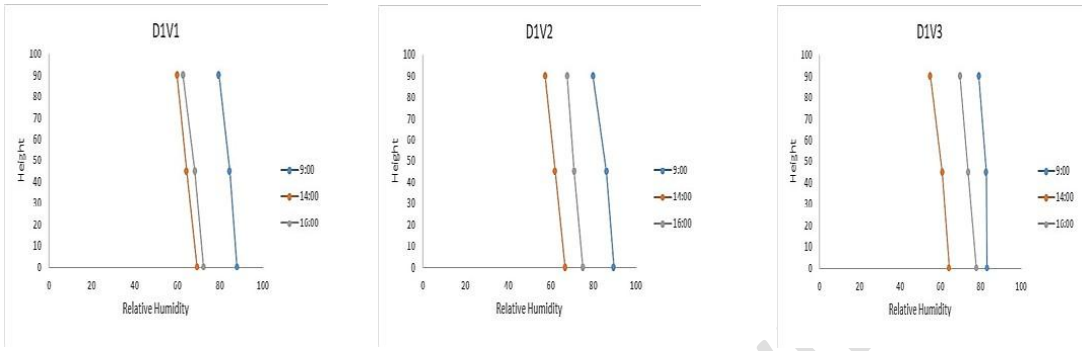
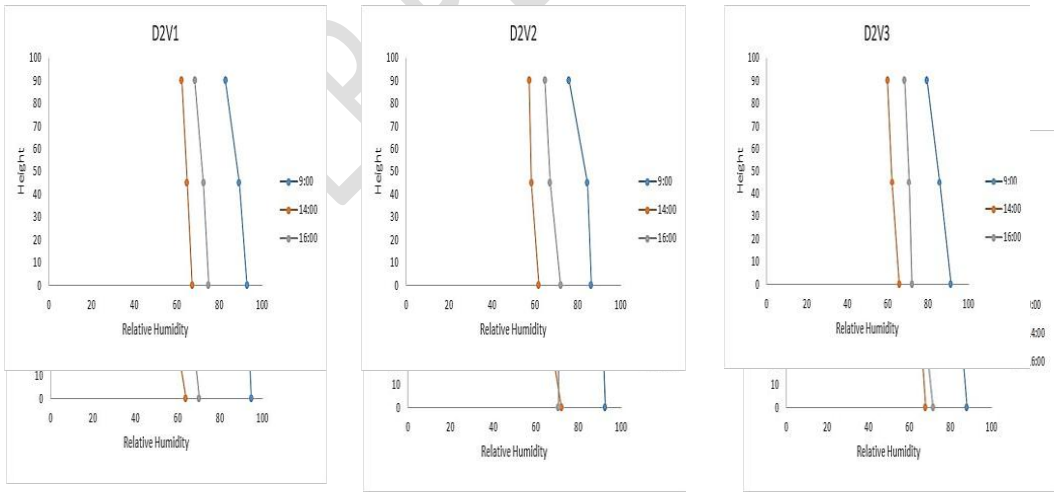


Fig. 4: Diurnal profiles of relative humidity in cluster bean crop at vegetative stage duringdifferentgrowing environments



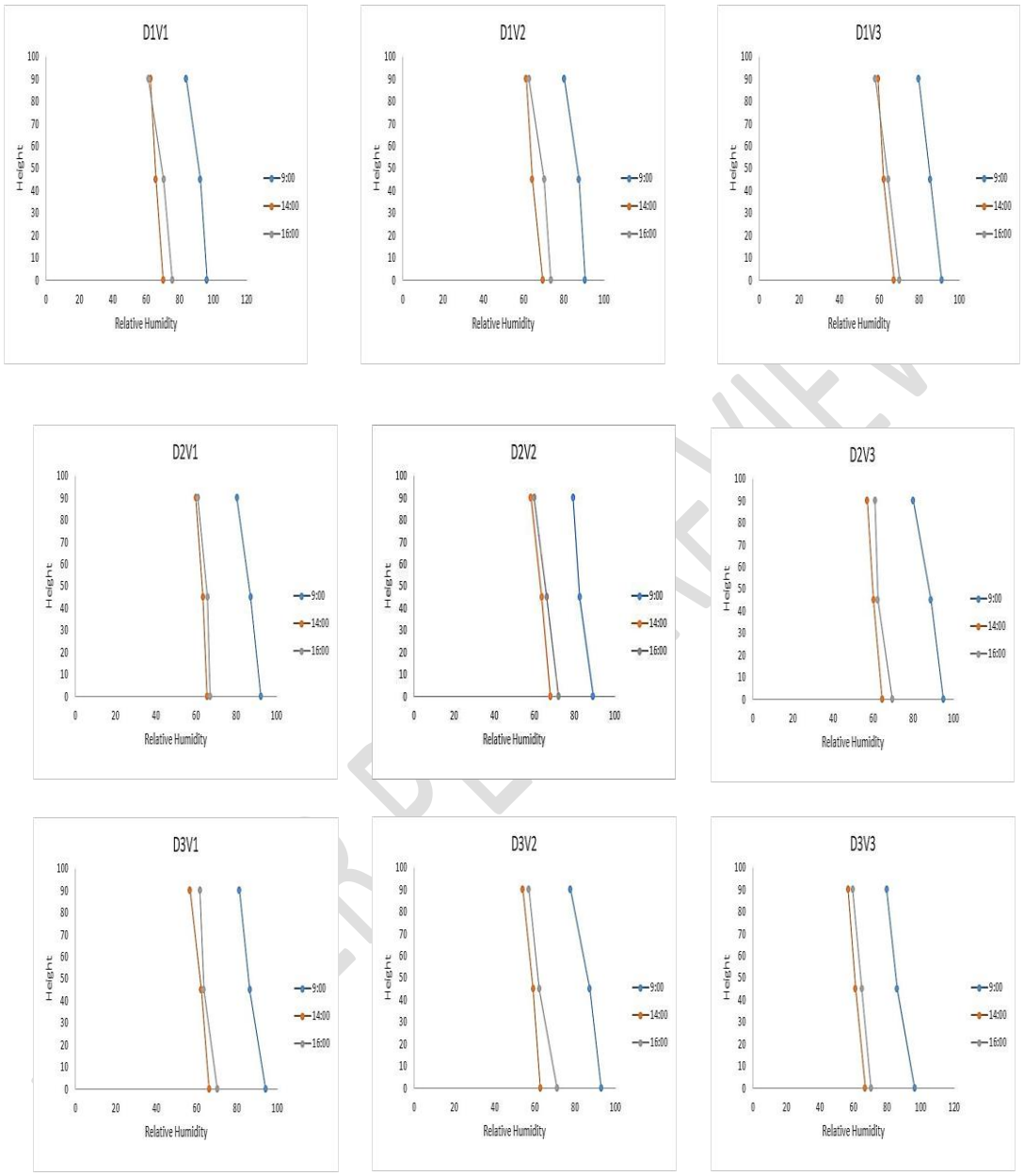


Fig. 5: Diurnal profiles of relative humidity in cluster bean crop at flowering stageduringdifferentgrowing environments

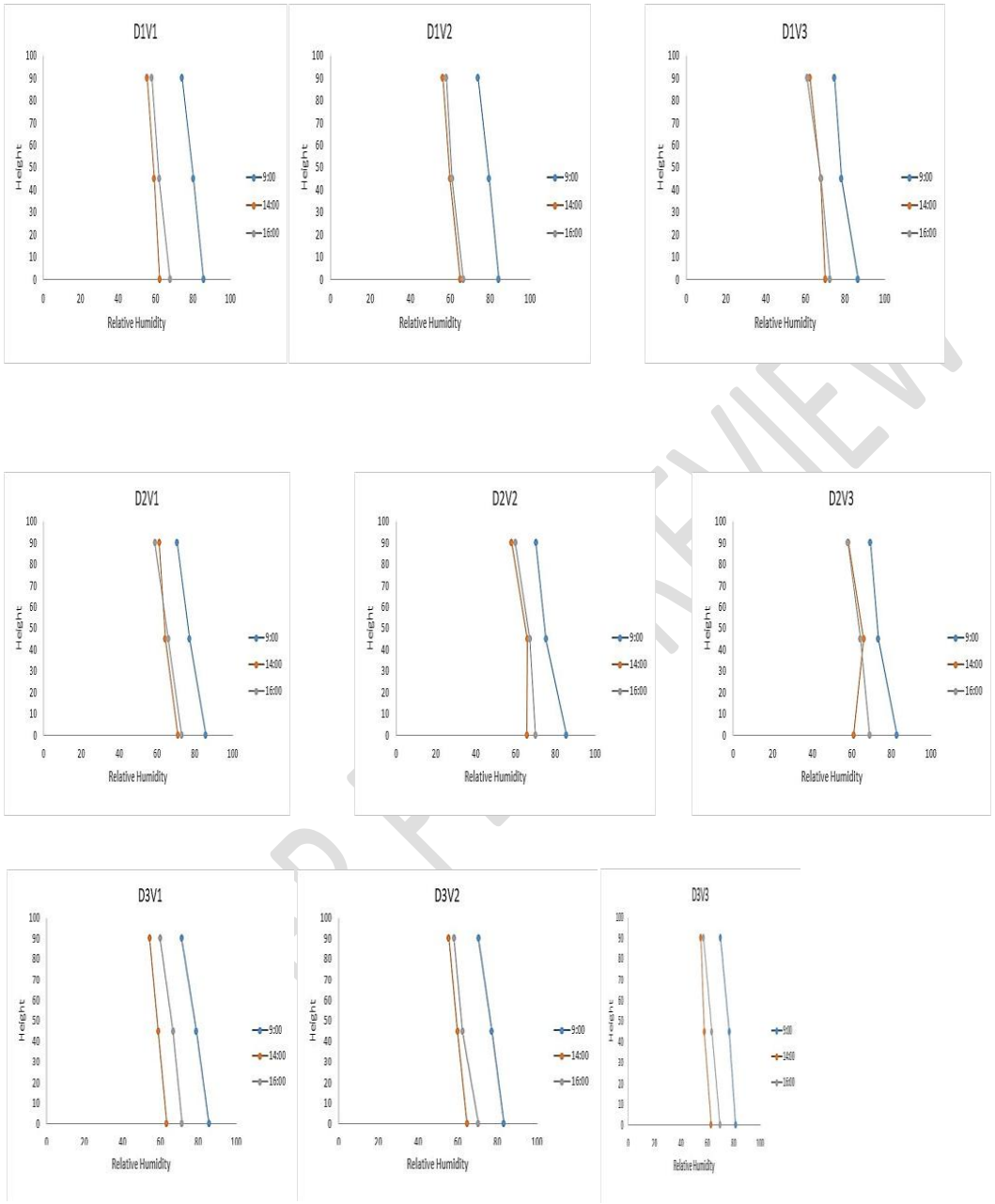


Fig.6:Diurnalprofilesofrelativehumidityinclusterbeancropatpodformationstageduringdifferentgrowing environments