

EFFECT OF SEASONAL VARIATIONS AND WEATHER PARAMETERS ON YIELD, QUALITY AND DISEASE INCIDENCE IN GUAVA CULTIVARS UNDER RAINFED CONDITIONS OF JAMMU REGION

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ABSTRACT

The six cultivars under the study were *Allahabad Safeda*, *Lucknow-49*, *Apple Colour*, *Hybrid 1* and *Hybrid 2* and *Banarsi Surkha*. *Lucknow-49* cultivar proved to be most successful variety with the highest fruit yield (78 and 114 kg tree⁻¹) followed by cv. *Allahabad Safeda* (61 and 88 kg tree⁻¹) in rainy and winter season, respectively. *Apple colour* cv. recorded lowest (24 kg tree⁻¹) fruit yield during rainy season however cv. *Hybrid-2* observed the lowest fruit yield (43 kg tree⁻¹) in winter season. Total soluble solids, total sugars and vitamin C were higher in winter season (14.5 %, 4.82 % and 221 mg 100 g⁻¹) than rainy season crop (10.6 %, 3.33 % and 157 mg 100 g⁻¹), respectively. The minimum disease incidence was recorded in cv. *Lucknow-49* (17.7 & 8.0 %) followed by *Allahabad Safeda* (21.0 & 11.9 %) at harvest in rainy and winter season, respectively. Maximum and minimum temperature, relative humidity (evening) and evaporation were negatively related in rainy season, whereas rainfall was positively related with disease intensity. Hence, it is concluded that winter season guava was more quantitative, qualitative and disease resistant as compared to rainy season crop under rainfed conditions.

INTRODUCTION

Guava (*Psidium guajava* L.) is a champion fruit belonging to family *Myrtaceae* and originated in tropical south America. It is one of the leading fruit crops in India due to wide adaptability to varying soil and climatic conditions (Sharma *et al.*, 2013). Guava has earned the popularity of 'poor man's apple' due to low fetching price available in plenty to every person during the season. It is no inferior to apple for its nutritive values. It is pleasant, sweet and refreshingly, acidic in flavour and emits sweet aroma. It is an excellent source of vitamin-C and pectin (Dhaliwal and Singla, 2002; Mahour *et al.*, 2012). It is considered to be one of the exquisite, nutritionally valuable and remunerative crops. Its cultivation is getting popularity due to increasing international trade, better nutritional contents and processing of its value added products (Sharma *et al.*, 2013a).

The major growing areas of guava fruit in India are in Uttar Pradesh, Bihar, Madhya Pradesh, Gujarat and Maharashtra states. However, in Jammu and Kashmir state, it is mainly grown in the areas of Jammu, Kathua, Samba, Reasi, Udampur, Rajouri, Poonch and Ramban districts. The total area under guava fruit in J&K State is 2478.6 ha with an annual production of 5100.9 MTs and a productivity of 2.06 MT/ha (Anonymous,

2015).

Guava has an important place among the tropical fruits but grown widely in sub-tropical regions also. Guava bears flowers and fruits more than once in a year (Dubey *et al.*, 2009; Aulakh, 2004). In most of the commercial cultivars, presence of large number of hard seeds, wilt and fruit fly seems to be the major factors responsible for restricting its cultivation (Sharma *et al.*, 2011). It has been observed that seasonal variations and different weather parameters generally affect the quality and quantity of guava cultivars especially under rainfed conditions. The study of seasonal variations in guava fruit characters and quality is required to evaluate commercial guava growing season and better performed cultivars. A study in that direction will provide ample opportunity to researchers to understand the different guava cultivars. Therefore, keeping the above point of view in mind, a study entitled, "Effect of Seasonal Variations and Weather Parameters on Yield, Quality and Disease Incidence in Guava cultivars under Rainfed Conditions of Jammu Region" was undertaken, with the following objectives:

To study the effect of seasonal variations and weather parameters in different guava cultivars on yield, quality and disease incidence.

MATERIALS AND METHODS

The present study entitled, "Effect of Seasonal Variations and Weather Parameters on Yield, Quality and Disease Incidence in Guava cultivars under Rainfed Conditions of Jammu Region" was conducted at Rainfed Research Sub-Station for Sub-Tropical Fruits (RRSS), Raya, SKUAST-Jammu on 15 years old trees of guava during rainy and winter seasons of 2010-11 and 2011-12. The treatments consist of six guava cultivars namely; T₁: *Allahabad Safeda*, T₂: *Lucknow-49*, T₃: *Apple Colour*, T₄: *Hybrid 1*, T₅: *Hybrid 2* and T₆: *Banarsi Surkha* and the experiment was laid out in randomized block design (RBD) with four replications.

During both the fruiting seasons (rainy and winter) ten fruits were taken randomly at commercial maturity and analyzed for yield and quality attributes.

Fruit-weight was measured by using digital balance (Indosaw805CH). Fruit length and fruit diameter was determined by digital Vernier Calliper (Mitutoyo) whereas; fruit yield data was recorded at the time of each picking. Titratable acidity was determined by using the standard procedures of Rangana (1977). Ascorbic acid was determined by using 2, 6-dichlorophenol indophenol dye (Ruck, 1969). Total soluble solids (TSS), reducing and total sugars were determined as per standard procedures given by A.O.A.C (1994). The data obtained was statistically analysed (Gomez and Gomez, 1984). The correlation analysis study was done by using SPSS16 software.

For disease incidence, in each variety three trees were selected randomly and in each tree fifty fruits were taken by stratified random sampling at fruit setting, full size of fruit and at harvest stages. The per cent disease was calculated by using the

following formula:

$$\text{Per cent disease incidence} = \frac{\text{No. of infected fruits}}{\text{Total no. of fruits observed}} \times 100$$

RESULTS AND DISCUSSION

Fruit size and yield

The data on fruit size like length and breadth was significantly more in cultivar *Lucknow 49* in rainy and winter season, which was immediately followed by cultivar *Allahabad Safeda*. However, the values obtained for length and breadth of guava fruit were higher in winter season as compared to the rainy season. Fruit weight (g) and fruit yield (kg tree⁻¹) was recorded higher during winter season crop in all the six cultivars of guava as compared to rainy season crop. The difference in average fruit weight might be due to varietal characteristics and agro-climatic conditions in which they are growing. There was a gradual increase in fruit size and weight during winter season over rainy season. This information was also supported by Singh *et al.* 2002 and Jana *et al.* 2009 under hilly region.

Statistically highest guava fruit yield was recorded in cv. *Lucknow 49* (78 & 114 kg tree⁻¹) which was followed by cv. *Allahabad Safeda* (61 & 88 kg tree⁻¹) in rainy and winter season, respectively. Whereas, the minimum fruit yield of guava was recorded in cv. *Apple colour* (24 kg tree⁻¹) in rainy season and cv. *Hybrid 2* (43 kg tree⁻¹) in winter season in both the years under study (Table 1). The fruit which set during August and mature during winter season attained more size and weight than harvested during rainy seasons. The probable cause may be that the winter season fruit-set occurred during August-September when plenty of food material is available in comparison to fruit set in April month. Apart from food

Table 1: Effect of seasonal variations on yield and fruit characteristics of different cultivars of guava

Cultivars	Fruit size (cm)						Fruit Yield (kg tree ⁻¹)					
	Rainy Season			Winter Season			Rainy Season			Winter Season		
	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean
<i>Allahabad Safeda</i>	5.5	5.9	5.7	6.9	6.5	6.7	7.4	7	7.2	7.5	7.3	7.4
<i>Lucknow-49</i>	6.3	6.7	6.5	7	6.8	6.9	7.6	7.2	7.4	7.9	7.5	7.7
<i>Apple Colour</i>	3.5	3.9	3.7	4.7	4.3	4.5	5.5	5.1	5.3	6.4	6	6.2
<i>Hybrid 1</i>	4.7	4.9	4.8	5.8	5.4	5.6	6.4	6	6.2	6.9	6.5	6.7
<i>Hybrid 2</i>	4.9	5.1	5	6	5.6	5.8	6.5	6.1	6.3	7.2	6.8	7
<i>Banarsi Surkha</i>	4.5	4.7	4.6	5.8	5.4	5.6	5.8	5.4	5.6	6.6	6.2	6.4
Mean	4.9	5.2	5.1	6	5.7	5.9	6.5	6.1	6.3	7.1	6.7	6.9
Range	3.5-6.3	3.9-6.7	3.7-6.5	4.7-7.0	4.3-6.8	4.5-6.9	5.5-7.6	5.1-7.2	5.3-7.4	6.4-7.9	6.0-7.5	6.2-7.7
CD (5 %)	0.08	0.1	0.06	0.64	0.63	0.41	0.07	0.1	0.06	0.64	0.09	0.33

Cultivars	Fruit Weight (g)			Fruit Yield (kg tree ⁻¹)		
	Rainy Season			Winter Season		
	2010	2011	Mean	2010-11	2011-12	Mean
<i>Allahabad Safeda</i>	128.4	149.3	138.9	175.6	155.3	165.5
<i>Lucknow-49</i>	148.2	157.8	153	204.5	189.7	197.1
<i>Apple Colour</i>	51.2	59	55.1	131.2	110	120.6
<i>Hybrid 1</i>	74.4	98.8	86.6	142.6	133.8	138.2
<i>Hybrid 2</i>	68.2	81.8	75	135.1	107.6	121.4
<i>Banarsi Surkha</i>	63	75.6	69.3	139	121.2	130.1
Mean	88.9	103.7	96.3	154.7	136.3	145.5
Range	51.2-148.2	59.0-157.8	55.1-153.0	131.2-204.5	110.0-189.7	120.6-197.1
CD (5 %)	6.4	5.7	7.3	9.5	8.2	14.3

Table 2: Effect of seasonal variation on quality parameters of different cultivars of guava

Cultivars	TSS (° Brix)						Acidity (%)					
	Rainy			Winter			Rainy			Winter		
	2010	2011	Mean	2010-11	2011-12	Mean	2010	2011	Mean	2010-11	2011-12	Mean
<i>Allahabad Safeda</i>	9	7	8	14	10	12	0.5	0.56	0.53	0.29	0.35	0.32
<i>Lucknow-49</i>	14	10	12	18	14	16	0.61	0.65	0.63	0.4	0.46	0.43
<i>Apple Colour</i>	12	8	10	14	12	13	0.39	0.43	0.41	0.28	0.34	0.31
<i>Hybrid 1</i>	13	11	12	16	14	15	0.46	0.52	0.49	0.42	0.48	0.45
<i>Hybrid 2</i>	10	8	9	18	12	15	0.32	0.38	0.35	0.24	0.28	0.26
<i>Banarsi Surkha</i>	14	12	13	17	15	16	0.41	0.47	0.44	0.34	0.38	0.36
Mean	12	9.3	10.6	16.2	12.8	14.5	0.45	0.5	0.48	0.33	0.38	0.36
Range	9-14	11-Jul	8-13	14-18	15-Oct	16-Dec	0.32-0.61	0.38-0.65	0.35-0.63	0.24-0.42	0.28-0.48	0.26-0.45
CD (5 %)	2.5	3.4	1.3	2.9	2	3.3	0.06	0.07	0.04	0.07	0.05	0.04

Cultivars	Vitamin C (mg 100 g ⁻¹ pulp)						Reducing sugars						Total sugars (%)					
	Rainy			Winter			Rainy			Winter			Winter					
	2010	2011	Mean	2010-11	2011-12	Mean	2010	2011	Mean	2010-11	2011-12	Mean	2010	2011	Mean	2010-11	2011-12	Mean
<i>Allahabad Safeda</i>	157	175	166	226	240	233	1.98	2.08	2.03	3.72	4.02	3.87	2.82	3.06	2.94	4.14	4.26	4.2
<i>Lucknow-49</i>	178	200	189	238	268	253	2.56	2.76	2.66	4.56	4.8	4.68	3.56	3.88	3.72	5.36	5.64	5.5
<i>Apple Colour</i>	142	160	151	202	220	211	2.06	2.34	2.2	3.84	4.16	4	2.96	3.12	3.04	4.28	4.42	4.35
<i>Hybrid 1</i>	136	168	152	217	235	226	2	2.28	2.14	3.8	4.1	3.95	3.42	3.7	3.56	5.28	5.56	5.42
<i>Hybrid 2</i>	128	150	139	187	205	196	2.26	2.52	2.39	4.46	4.62	4.54	3.01	3.19	3.1	4.06	4.2	4.13
<i>Banarsi Surkha</i>	136	156	146	192	218	205	2.34	2.54	2.44	4.52	4.68	4.6	3.5	3.76	3.63	5.16	5.42	5.29
Mean	146	168	157	210	231	221	2.2	2.42	2.31	4.15	4.4	4.28	3.21	3.45	3.33	4.71	4.92	4.82
Range	128-178	150-200	137-189	187-238	205-268	196-253	1.98-2.56	2.08-2.76	2.03-2.66	3.72-4.80	4.02-4.80	3.87-4.68	2.82-3.56	3.06-3.88	2.94-3.72	4.06-5.36	4.20-5.64	4.13-5.50
CD (5 %)	5.5	8.6	10.3	15.5	39.1	23.8	0.28	0.46	0.17	0.22	0.24	0.22	0.32	0.26	0.29	0.19	0.35	0.17

Table 3: Correlation between fruit yield and size with quality parameters of different cultivars of guava fruit during rainy season under rainfed conditions

	Fruit Length	Fruit Breadth	Fruit Weight	Fruit Yield	TSS	Acidity	Vitamin-C	Reducing Sugars	Total Sugars
Fruit Length	1	.898**	.938**	.947**	-.148	.777**	.724**	.429	.352
Fruit Breadth	.898**	1	.838**	.825**	.023	.604*	.434	.138	.134
Fruit Weight	.938**	.838**	1	.984**	-.239	.883**	.827**	.255	.233
Fruit Yield	.947**	.825**	.984**	1	-.165	.899**	.839**	.317	.305
TSS	-.148	.023	-.239	-.165	1	-.007	-.257	.127	.474
Acidity	.777**	.604*	.883**	.899**	-.007	1	.914**	.340	.515
Vitamin- C	.724**	.434	.827**	.839**	-.257	.914**	1	.518	.462
Reducing Sugars	.429	.138	.255	.317	.127	.340	.518	1	.699*
Total Sugars	.352	.134	.233	.305	.474	.515	.462	.699	1

**Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed)

Table 4: Correlation between fruit yield and size with quality parameters of different cultivars of guava fruit during winter season under rainfed conditions

	Fruit Length	Fruit Breadth	Fruit Weight	Fruit Yield	TSS	Acidity	Vitamin-C	Reducing Sugars	Total Sugars
Fruit Length	1	.984**	.921**	.725**	.161	.166	.525	.008	.052
Fruit Breadth	.984**	1	.915**	.707*	.251	.071	.427	.090	.011
Fruit Weight	.921**	.915**	1	.902**	.253	.313	.620*	.134	.276
Fruit Yield	.725**	.707*	.902**	1	.144	.345	.668*	.200	.340
TSS	.161	.251	.253	.144	1	.012	-.333	.258	.348
Acidity	.166	.071	.313	.345	.012	1	.732**	.131	.892**
Vitamin- C	.525	.427	.620*	.668*	-.333	.732**	1	.101	.486
Reducing Sugars	.008	.090	.134	.200	.258	.131	.101	1	.385
Total Sugars	.052	.011	.276	.340	.348	.892**	.486	.385	1

**Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed)

materials, climatic factors such as temperature and humidity prevailing during winter season are also favourable for development of fruits. The results are more or less coinciding with the findings given of Aulakh and Kamboj, 1996 and Jana et al. 2014. The fruit yield of *Lucknow-49* cultivar was more than *Allahabad safeda* cultivar under Punjab conditions (Aulakh, 2004).

Quality parameters

Besides productivity, fruit quality is another concern in assessing the performance of guava cultivars under rainy and winter seasons. Fruit quality characteristics values like total soluble solids (TSS), vitamin C, reducing sugars and total sugars were found superior during winter season as compared to the rainy season except the values obtained for quality parameter acidity where the values were higher in rainy season as compared to the winter season for all the six cultivars in both

Table 5: Correlation coefficients between disease intensity and weather parameters at different stages in guava crop during rainy and winter seasons

Parameters	Rainy season				Winter season			
	P ₁	P ₂	P ₃	P ₄	P ₁	P ₂	P ₃	P ₄
Max. Temperature (°C)	-0.27	-0.52	-0.36	-0.51**	-0.24	0.24	-0.58*	-0.81**
Min. Temperature (°C)	-0.31	-0.26	0.38	-0.83**	-0.10	-0.06	-0.46	-0.66**
RH m (%)	0.73**	-0.07	-0.07	-0.06	0.34	-0.14	0.47	0.71**
RH e (%)	0.69*	-0.48	-0.34	-0.42*	0.11	0.14	0.09	0.44**
Evaporation (mm)	-0.74**	0.43	-0.29	-0.72**	-0.23	0.18	-0.33	-0.30
Rainfall (mm)	0.11	0.03	0.18	0.42*	0.04	0.18	0.40	0.37*

P₁- Fruit setting stage, P₂- Full size of fruit, P₃- At time harvesting of fruit, P₄- whole season

Table 6: Prediction of acidity and vitamin C of guava fruit during rainy season under rainfed conditions of Jammu region

S. No.	Acidity Equation	R ²	Vitamin-C Equation	R ² (mg 100 g ⁻¹ pulp)
1	Y = 0.083X ₁ + 0.049	0.61	Y ₁ = 16.33X ₁ + 74.28	0.54
2	Y = 0.072X ₂ + 0.050	0.37	Y ₁ = 10.80X ₂ + 93.62	0.19
3	Y = 0.002X ₃ + 0.249	0.8	Y ₁ = 0.451 X ₃ + 112.9	0.7
4	Y = 0.004X ₄ + 0.264	0.85	Y ₁ = 0.897X ₄ + 116.1	0.74

Y = Acidity of fruit (%)
 X₁ = Fruit length (cm)
 X₂ = Fruit breadth (cm)
 X₃ = Fruit weight (g)
 X₄ = Fruit yield (kg)

Y₁ = Vitamin-C in fruit (mg/100 g pulp)
 X₁ = Fruit length (cm)
 X₂ = Fruit breadth (cm)
 X₃ = Fruit weight (g)
 X₄ = Fruit yield (kg)

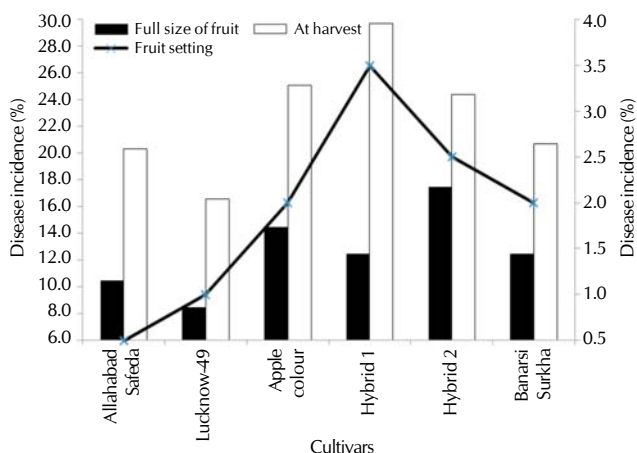


Figure 1: Disease incidence in different cultivars of guava fruit during rainy season of 2010

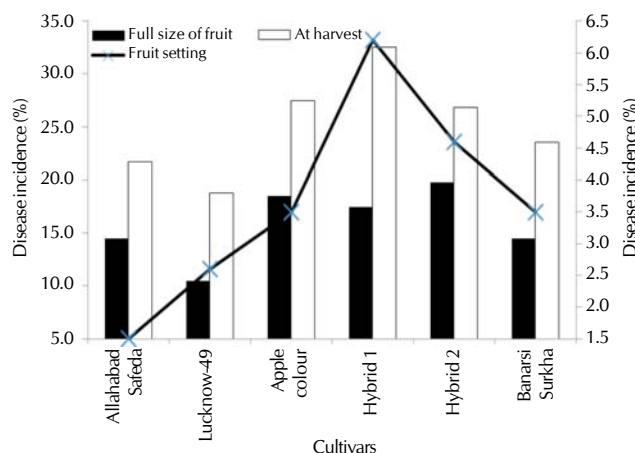


Figure 2: Disease incidence in different cultivars of guava fruit during rainy season of 2011

the years under study. Aulakh, 2004, Sidhu *et al.* (1996) also found superior fruit quality characteristics during winter season as compared to rainy season fruits.

Statistically superior values of TSS was found in cv. *Banarsi Surkha* (13°Brix) during rainy season and was followed by cv. *Lucknow 49* (12°Brix). However, during winter season the maximum value of TSS was shared by cvs. *Lucknow 49* and *Banarsi Surkha* (16°Brix). The similar results were also recorded by Aulakh, 2004. The maximum values of quality parameter like acidity (%) was recorded in cv. *Lucknow 49* (0.63%) which was immediately followed by cv. *Allahabad Safeda* (0.53%) and the minimum value of acidity (0.35%) was recorded in cv. *Hybrid 2* during the rainy season. In winter season, statistically higher values of quality parameter acidity were observed in cv. *Hybrid 1* (0.45%); which was immediately

followed by cv. *Lucknow 49* (0.43%) and the minimum values were again recorded in cv. *Hybrid 2* (0.26%).

The vitamin-C values were higher in winter season fruit as compared to rainy season crop. However, statistically significant values of vitamin C content were found with cv. *Lucknow 49* in rainy as well as winter season and were followed by cv. *Allahabad Safeda* in both the years under study. Rainy season fruit contains less vitamin-C, TSS and sugar. This might be due to cloudy weather and presence of relatively more moisture in soil which must have moved in to the fruit and diluted the organic metabolites particularly sugars. The results corroborate the findings of Jana *et al.* (2014).

The values of quality parameters like reducing and total sugars were significantly superior in cv. *Lucknow 49* and were followed by cv. *Banarsi Surkha* in rainy and winter season

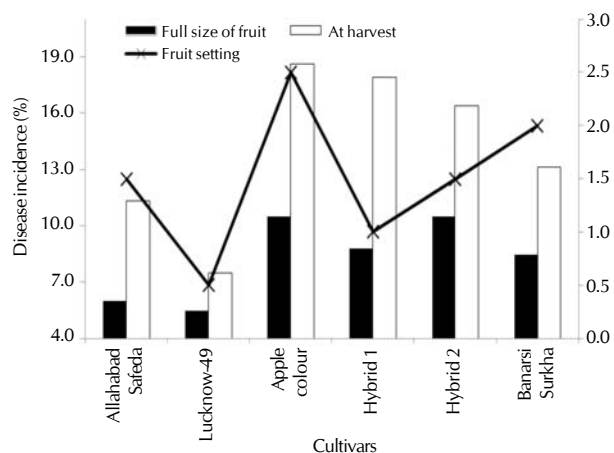


Figure 3: Disease incidence in different cultivars of guava fruit during winter season of 2010-11

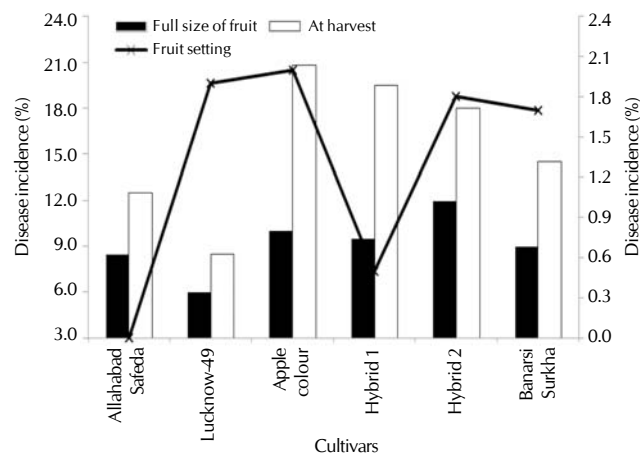


Figure 4: Disease incidence in different cultivars of guava fruit during winter season of 2011-12

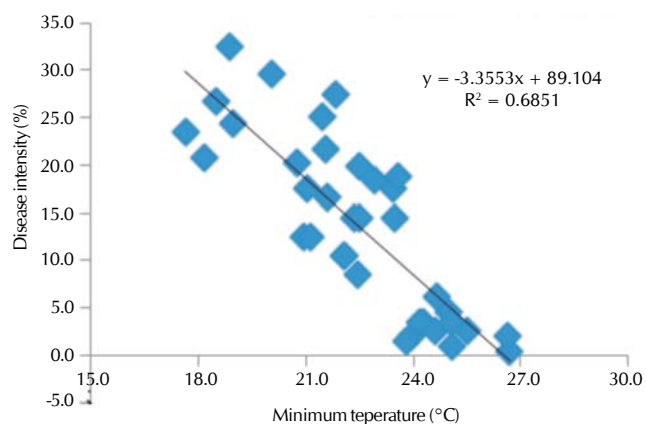


Figure 5: Relationship of disease intensity in guava fruit and minimum temperature during rainy season

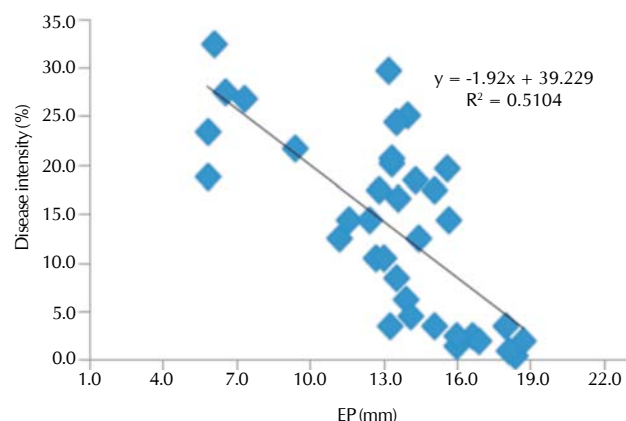


Figure 6: Relationship of disease intensity in guava fruit and evaporation during rainy season

crops in the years 2010-11 and 2011-12. Overall, fruit quality characteristics were found superior during winter seasons as compared to the rainy seasons (Table 2). Similar results were also reported by Sidhu *et al.*, 1996 and Singh *et al.*, 1976. The overall superiority of *Lucknow-49* and *Allahabad safeda* might be due to genetic make-up which got favourable microclimate in sub-tropical region of Jammu to express its characteristics.

Correlation study

It is evident from the correlation study that length and breadth of the fruit decided the fruit weight and finally yield of guava fruit crop during both the seasons. Acidity in guava fruit is highly correlated with length, breadth, fruit weight and yield during rainy season; whereas it was not correlated during winter season. Fruit weight and fruit yield per plant was highly correlated (0.01) with vitamin C during rainy season, but was less correlated (0.05) during winter season. Length of fruit during rainy season was also significantly correlated with vitamin C; whereas no significant relationship was observed during winter season. Acidity was significantly differed with vitamin C and yield and yield attributes of guava fruit crop during rainy season. Acidity was highly significantly correlated with vitamin C and total sugars during winter season (Table 3

and 4).

The disease intensity at fruit setting, full size of fruit and harvesting stages was less correlated as compared to whole season. The morning and evening relative humidity (RH m & RH e) was positively correlated while evaporation was negatively correlated with disease intensity at fruit setting stage of guava during rainy season. But in case of rainy season the maximum and minimum temperature, evening relative humidity (RH e) and evaporation were negatively related, whereas rainfall was positively related with disease intensity. In winter season, maximum temperature at the time of harvesting was found negatively correlated. In whole season the disease intensity were negatively related with maximum and minimum temperature, while relative humidity morning and evening and rainfall were positively correlated (Table 5).

Guava fruit yield during rainy season have higher values of vitamin C and acidic, as compared to winter season fruit. The acidity and vitamin C during rainy season can be determined with the help of yield and other parameters of guava fruit crop. The acidity in guava fruit varied with fruit weight and yield with an accuracy of 80 and 85 per cent, respectively; however, in case of vitamin C with an accuracy of 70 and 74 per cent, respectively. The length of guava fruit also influenced acidity

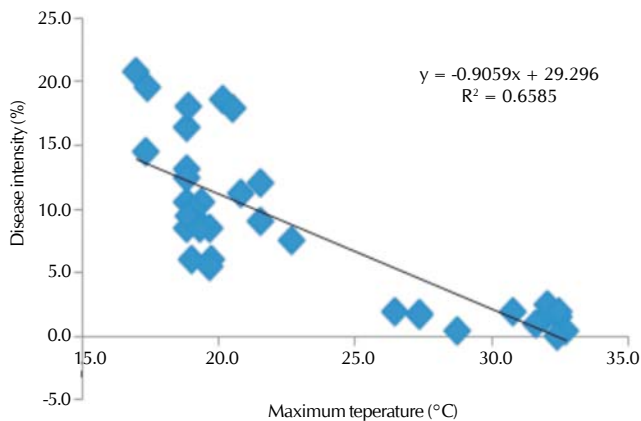


Figure 7: Relationship of disease intensity in guava fruit and maximum temperature during winter season

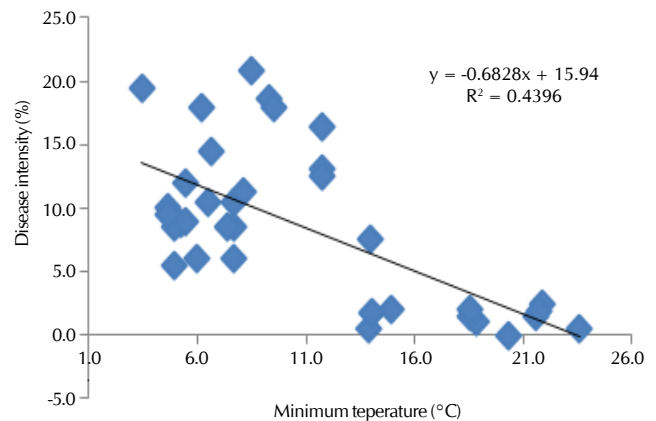


Figure 8: Relationship of disease intensity in guava fruit and minimum temperature during winter season

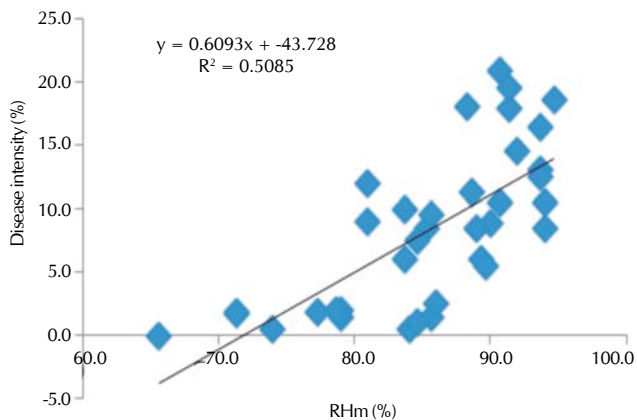


Figure 9: Relationship of disease intensity in guava fruit and relative humidity (morning) during winter season

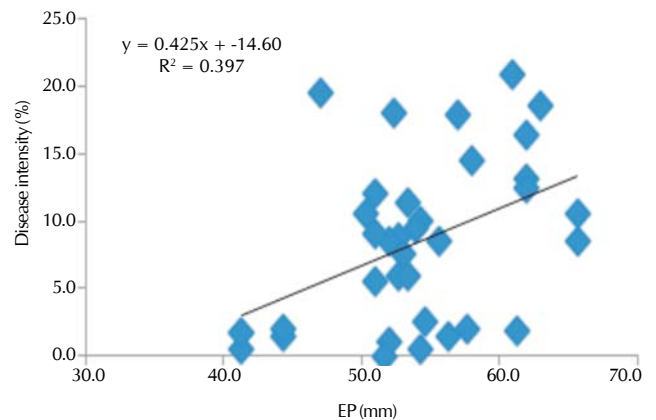


Figure 10: Relationship of disease intensity in guava fruit and evaporation during winter season

and vitamin C of the fruit during rainy season in rainfed areas of sub tropical conditions of Jammu region (Table 6).

Disease incidence

The incidence of disease was more during rainy season as compared to winter season at stages fruit setting, full size of fruit and at harvest in all the cultivars of guava fruit. However, percentage of disease incidence was more at harvest as compared to the other two stages in all the cultivars under both the seasons. The minimum incidence of diseases was recorded in cv. *Lucknow 49* followed by cv. *Allahabad Safeda* and cv. *Banarsi Surkha* during both the rainy and winter season. The maximum incidence of diseases was recorded in cv. *Hybrid 1* and cv. *Apple Colour* during both seasons (Fig. 1, 2, 3 & 4). Higher incidence of diseases during rainy season as compared to the winter season crop may be due to extreme temperature and more relative humidity which are favourable for incidence of different diseases. Pandey *et al.* (1997) also found the similar results.

In rainy season, disease intensity was negatively related with minimum temperature and evaporation in guava fruit. Disease intensity decreased with an increase in minimum temperature (°C) and evaporation (mm) and is explained with accuracy of 69 and 51 %, respectively (Fig 5 & 6). The disease intensity

was negatively related with maximum and minimum temperature during winter season. With an increase of 0.91°C and 0.68°C of maximum and minimum temperature; disease intensity decreased per percentage with accuracy of 66 and 44 %, respectively (Fig 7 & 8). An increase in morning relative humidity at the rate of about 0.61 per cent enhanced the disease intensity by 1 % with a regression coefficient of 0.51. The evaporation rate also influenced the occurrence of disease intensity with the rate of 0.40 mm/per cent (Fig 9 and 10).

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