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Epidemiology and management of stemphylium blight of garlic caused by *Stemphylium vasicarium* (Wallr.)

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Abstract
The disease stemphylium blight mostly developed when temperature ranged between 16.42 °C to 17.40 °C minimum and 31.0 °C to 33.90 °C maximum as well as relative humidity 63.10 to 63.60 per cent respectively. For the management strategy of the disease, when garlic was sown in single row along with carrot in double row as inter cropping, the disease was minimum 26%, it was due to secreting the secondary plant substances by companion crop (carrot), which affects the intensity of pathogen. In sowing time study, affect on disease intensity was affected by sowing 1st October; there was less disease intensity (40.50% and 38.20% in 2003-04 and2004-05 respectively) as compared to sowing on 1stDecember. In term of yield q/ha., there were maximum yield 112.60 and 110.8 respectively in 16th October sowing crop in both the year (2003-04 and 2004-05). In varietal screening, twenty four varieties / germplasm were screened under natural conditions. None of the varieties / germplasm was found immune, resistant and moderately resistant. The six varieties/germplasm were found to be moderately susceptible (MS), six varieties / germplasm were susceptible (S) and remaining twelve varieties /germplasms were found to be highly susceptible. Screening of six extract of plant species *viz. Azadirachta indica, Datura metel, Lantana camara, parthenium hyserophores, Ocium spp.and Argimone mexicana etc.* were tested *In vitro* against *Stemphylium vasicarium* and found that plant extract of *Azadirachta indica* gave (66.5 per cent) and *Datura metel* gave (64.5 per cent) in habitation over control.

Keywords: Epidemiology, stemphylium blight, cultural practices, varietal screening, plant extract, garlic and *Stemphylium vasicarium*

Introduction
Garlic (*Allium sativum* L.) is the second most important bulb crop and used as spices or condiments after onion throughout India (Singh & Srivastava, 1999) [11]. It possesses medicinal value due to presence of volatile oil and sulpher compound. It is an antiseptic, antibiotic in action, therefore, it is given in acute bronchitis and cold, even it relieves in tuberculosis. Apart from this, it is gastric stimulant, which helps in digestion and anathematic, as well as to remove worms (Ansari and Saraf, 2005) [1]. The area, production and productivity of garlic in India were 164860 ha., 833970 mt. and 5.1mt/ha respectively (N.H.B., 2010) [14]. Garlic crop is affected from number of diseases from fungal origin; one of them is Stemphylium blight caused by *Stemphylium vasicarium* and is responsible for reduction and uncertain yield of garlic crop. Incidence of this disease ranged between 5.0–43.2 per cent (Jakhar *et al*., 1994) [6]. Crop is severely affected by epidemiological factors (temperature, rainfall and relative humidity etc.) and predisposing factors such as surviving on plant debris in soil. Varietal screening and plant extract are also responsible the disease restriction and increasing crop growth. Keeping in view the importance of crop and severity of disease the management strategies became essential. Hence an experiment was conducted against this disease.

Materials and Methods
Collection and Isolation of the pathogen and pathogenecity test
Naturally infected leaves showing the characteristics symptom of *Stemphylium* leaf blight collected from infected field of garlic form different place of university of guideless area of U.P. and maintained in P.D.A. (Potato Dextrose Agar) medium. The symptomatological and morphological characters of the fungus were studies and pathogenicity was proved on host leaves.

A. Epidemiological studies

a. Effect of abiotic environmental factors (Temperature, relative humidity and rainfall) on disease development *In vivo*

To find out the role of abiotic environmental factors in disease development and severity of stemphylium blight, the garlic variety G-15 was sown in experimental plot during two crop seasons *viz.*; 2003-04 and 2004-05. The experiments were conducted purely in randomized block design with three replications. The infection was recorded at fortnightly interval and it was correlated with the weather data such as maximum and minimum temperature, relative humidity (R.H.), rainfall and per cent disease intensity recorded. The data were tabulated and were critically analyzed to ascertain the most conducive temperature, rainfall and R. H. for development of the disease.

B. Cultural Management

a. Effect of intercropping of Garlic with carrot on disease intensity

The effect of intercropping with carrot along with sole crop of garlic with recommended agronomic practices and observation on disease intensity was recorded. The experiments was conducted in five treatments, T_1 control (single crop grown), T_2 Garlic (single row) + carrot (single row), T_3 garlic (single row) + carrot (double row), T_4 garlic (double row) + carrot (single row) and T_5 garlic (double row) and carrot (double row) with four replication and observation on the intensity of the disease with disease initiation time were recorded and analyzed statistically.

b. Effect of sowing dates on disease intensity

To evaluate the effect of dates of sowing the garlic variety G-15 was sown on five different dates at 15th day's interval as 1st October, 16th October, 31th October, 15th November and 30th November in two consecutive years with four replications. The average disease incidence was recorded in both the years *viz.*; 2003-04 and 2004-05. and yield data in q/ha was also recorded after harvesting.

C. Screening of varieties/germplsm agaist the disease

Screening trial was conducted under natural condition in the field at Vegetable Research Farm, Kalyanpur of C. S. Azad University of Agriculture and Technology, Kanpur during Rabi season. 24 garlic varieties/germplasm were selected for screening under field condition against the disease. The each variety was sown (plot size, no. of plant per plot and spacing 30 X 20 cm respectively) in single plot separately with recommended agronomic practice. Disease intensity was recorded on the basis of percentage leaf area affected in ten leaves from each variety and tagging takes place for observation. The observations of disease on leaf spot infection were recorded on the basis of 0-5 scale.

Rating scale per cent area infection

0=No infection
1=1 to 20 per cent necrotic leaf area
2=21 to 40 per cent necrotic leaf area
3=41 to 60 per cent necrotic leaf area
4=61 to 80 per cent necrotic leaf area
5=Above 80 per cent necrotic leaf area

The disease reaction against garlic of the varieties / germplasm was finally made as under.

Grading.

PDI		REACTION
0.0 to 10.0	=	Resistant (R)
10.1 to 20.0	=	Moderately resistant (MR)
20.1 to 40.0	=	Moderately susceptible (MS)
40.1 to 60.0	=	Susceptible (S)
Above 60.0	=	Highly Susceptible (HS)

The per-cent disease intensity (PDI) was calculated by using the following formula-

$$PDI(\%) = \frac{\text{S of rating of infected leaves observed}}{\text{No. of leaves observed} \times \text{Maximum disease score}} \times 100$$

D. *In vitro* evaluation of plant extracts

The relative efficacy six plants extracts *viz. Azadirachta indica, Datura metel, Lantana camara, Parthenium hystorophosun, Ocium* spp. and *Argemone mexicana* were tested against the pathogen in laboratory. Fresh and healthy leaves of all six test plants were collected from the surrounding university field for the preparation of plant extract. The leaves were first washed under running tap water to remove dust material adhering to be surfaces and then in distilled water. One hundred grams (100 g) leaves from each sample were then grinded with sterile water (100 ml) at 1:1 w/v in a pestle and mortar. After through grinding the extract was filtered through muslin cloth and then through what man filter paper no1. Later the extract was passed through Seitz filter to free them from bacterial contamination. The extract is then used as standard plant extract solution of 100 per cent concentration or 1:1 ratio. Prepared plant extract were treated at 60 ^{0}C for 15 minutes for destruction of other microorganism contamination. Five ml of each extract was in corporate in sterilized molten 100 ml of P.D.A. medium and poured into sterilized Petri plates (in 20 mm in size). Each treatment have three replication were maintained and allowed to solidity. A circular disc of 5 mm diameter was taken from 15 days old culture of the pathogen, cut by sterilized Cork-borer and placed in the centre of each Petri plate containing solidified plant leaves extract. The plants were incubated at 25 ± 1 ^{0}C. The efficacy of lantana leaves extract were assessed by measuring the growth of mycelium colony diameter in mm and interpreted in per cent inhibition over control. The per cent inhibited over control was calculated by formula reported by Bliss (1934) [3].

$$\text{Per cent inhibited over control} = \frac{C - T}{C} \times 100$$

Where, C= Growth of fungus in control, T= Growth of fungus in treatment

Results and Discussion

A. Effect of abiotic environmental factors on disease development

The survey on prevalence of Stemphylium blight indicated that the disease was prevalent in moderate to severe form. The disease intensity varied between 19 to 46 per cent. Perusal of results depicted in Table–1 & Graph -1 show that maximum disease intensity was 39.4% when average temperature was 17.4 to 33.9 °C and averages R.H. were 63.10 per cent, respectively. There was no effect of rainy days. It was also noted that the comparatively disease was more during 2003-

04 on account of increase in the temperature and relative humidity. Suheri & Price (2000b) [13], reported that the infection of onion of *A. pori* and *Stemphylium vesicarium* comes in controlled temperature between 4 to 25 °C with leaf wetness period (0-24 hours). Cora and Radriguez (2001) have also studied the effect of three temperatures (5, 21 and 28 °C) and relative humidity (80, 90 and 100 per cent) on onion leaf blight caused by *Stemphylium botryosum* and *Alternaria alternata*. The result indicates that there was high influence of temperature, and relative humidity on sporulation & disease development. Where as there was no effect of rain fall on sporulation and disease development.

B. Cultural Management

a. Effect of intercropping of garlic with carrot on disease intensity

Table – 2 & Graph-2 showed that when garlic was sown in single row along with carrot in double rows, the disease intensity was minimum (26%). The intercropping of garlic with carrot might be detrimental to the pathogen due to various secondary plant substances secreted by companion crop which affect the infection and intensity of pathogen. (Quais, *et al.*, 2005) [10]. Mueller, *et.al*. (2004) [8] also reported that, the intercropping cultivation of garlic (*Allium sativum*) and carrot (*Daucus carota*) in Jaboticabal, Sappaulo, Brazil and it was profitability than that of monoculture of garlic crop.

b. Effect of sowing dates on garlic disease intensity

Table–3 & Graph -3 indicates that when garlic was shown on 1st December, the disease intensity was minimum 30.00% and 29.50% in where as 1st October sown crop show maximum disease intensity, 40.50% and 38.20% during both the years. Regarding the yield data maximum yield was obtained from the crop sown on 16th October 112.60g. and 110.80g. during both the consecutive years. Similarly Jakhar, *et al*. (1994) [6] observed that stemphylium blight incidence of onion was influenced by sowing dates, in their study, the highest disease incidence (52.2%) was recorded when the crop was sown on October, 30th and the lowest disease incidence (29.6%) was observed when the crop was sown on November 30th. Mathur (1996) [7] has reported that maximum coefficient of disease index 57.5 in the crop sown during 2nd fortnight of December. Disease incidence increased in old plants and reached its peak at harvesting time.

C. Screening of varieties / germplsm agaist the disease

Table-4 indicated that out of Twenty four varieties / germplasm screened under natural conditions. None of the varieties / germplasm were found immune (I), resistant (R) and moderately resistant (MR). The six varieties/ germplasm were found to be moderately susceptible (MS), six varieties / germplasm were susceptible (S) and remaining twelve varieties /germplasms were found to be highly susceptible (HS) under natural condition. None of the variety was found immune. Some result has been reported by Bist and Thomas, (1992) [2] and Srivastava *et al*, (2005) [12].

D. *In vitro* effect of plant extract

The result presented in the Table-5 & Graph-4 show that out of six plant extract *Azadirachta indica* gave (66.5 per cent inhibition over control) and minimum 29.4 mm fungal colony growth. Next best plant extract was *Datura mental*, which gave 31.0mm fungal growth and 61.5% inhibited ouer the control. Prasad and Barnwal (2004), also evaluated that effect of leaf extract of *Azadirachta indica*, *Pongomia phnata*, *Datura mental*, *Ocium santam* (*O. tenuitisrum*), *Eucaplutus citriodera* and *Mentha arvensis* an *Stemphylium* blight of onion (cv. N-53) in field trial.

Table 1: Effect of Atmospheric factors (Temperature, Relative humidity. & Rainfall) on disease development under natural condition during 2003-04and 2004-05

2003-2004						2004-2005						Average 2003-04 and 2004-05				
Stand. week	Temp. °C		R. H (%)	Rain fall (mm)	Disease intensity (%)	Stand week	Temp. °C		R. H (%)	Rain fall (mm)	Disease intensity (%)	Stand. week	Temp. °C		R. H (%)	Rain fall (mm)	Disease intensity (%)
	Min.	Max.					Max.	Min.					Max.	Min.			
5	8.7	19.8	83.9	3.8	4.6	5	9.2	19.2	86.6	9.2	5.5	5	8.95	18.85	85.25	6.5	5.05
6	8.0	23.8	86.0	0.0	6.0	6	10.2	24.8	81.0	0.0	8.0	6	9.30	24.3	83.50	0.0	7.0
7	10.5	25.5	88.1	0.0	15.6	7	14.5	26.6	69.8	0.0	19.4	7	12.50	26.05	78.95	0.0	17.5
8	13.5	27.5	91.5	0.0	21.5	8	10.9	24.2	67.3	0.0	21.2	8	12.20	25.85	79.40	0.0	21.35
9	13.2	30.1	51.8	0.0	32.5	9	14.3	29.8	60.1	0.0	30.7	9	13.75	29.95	55.95	0.0	31.6
10	14.4	30.3	61.6	0.0	37.5	10	16.9	20.4	67.3	6.7	32.0	10	15.65	25.35	64.45	3.35	34.75
11	17.4	33.9	63.1	0.0	40.8	11	16.4	31.6	63.6	0.0	38.0	11	16.9	32.75	63.35	0.0	39.40
12	18.7	36.6	47.4	0.0	40.8	12	17.6	33.1	43.4	0.0	38.0	12	18.15	34.85	45.40	0.0	39.40
13	17.1	36.7	42.9	0.0	40.8	13	17.8	34.4	40.6	0.0	38.0	13	17.45	35.55	41.75	0.0	39.40
14	20.2	38.2	47.0	0.0	40.8	14	16.5	37.2	26.9	0.0	38.0	14	18.35	37.7	36.95	0.0	39.40
15	24.3	40.6	43.8	0.0	40.8	15	18.8	36.0	35.3	0.0	38.0	15	21.55	38.3	39.45	0.0	39.40
16	27.1	41.7	35.5	0.0	40.8	16	19.2	40.1	47.7	0.0	38.0	16	23.15	40.9	41.6	0.0	39.40

Table 2: Effect of Intercropping of garlic with carrot against disease intensity

Treatments	Intercropping	Disease intensity in %		Yield(q/ha)	
		2003-04	2004-05	2003-04	2004-05
T_1	Control (Garlic sole)	46.00	44.60	80.24	84.00
T_2	Garlic (Single row) + Carrot (Single rows)	36.00	34.90	90.68	92.00
T_3	Garlic (Single row) + Carrot (double rows)	26.00	25.60	100.16	103.00
T_4	Garlic (double rows) + Carrot (Single row)	40.00	38.80	86.56	88.10
T_5	Garlic (double rows) + Carrot (double rows rows)	32.00	31.40	98.15	98.60
C.D. at 5%		1.009		1.632	0.936
S.Em±		0.4763		0.770	0.441

Table 3: Effect of Alternate date of sowing on disease Intensity & yield of garlic

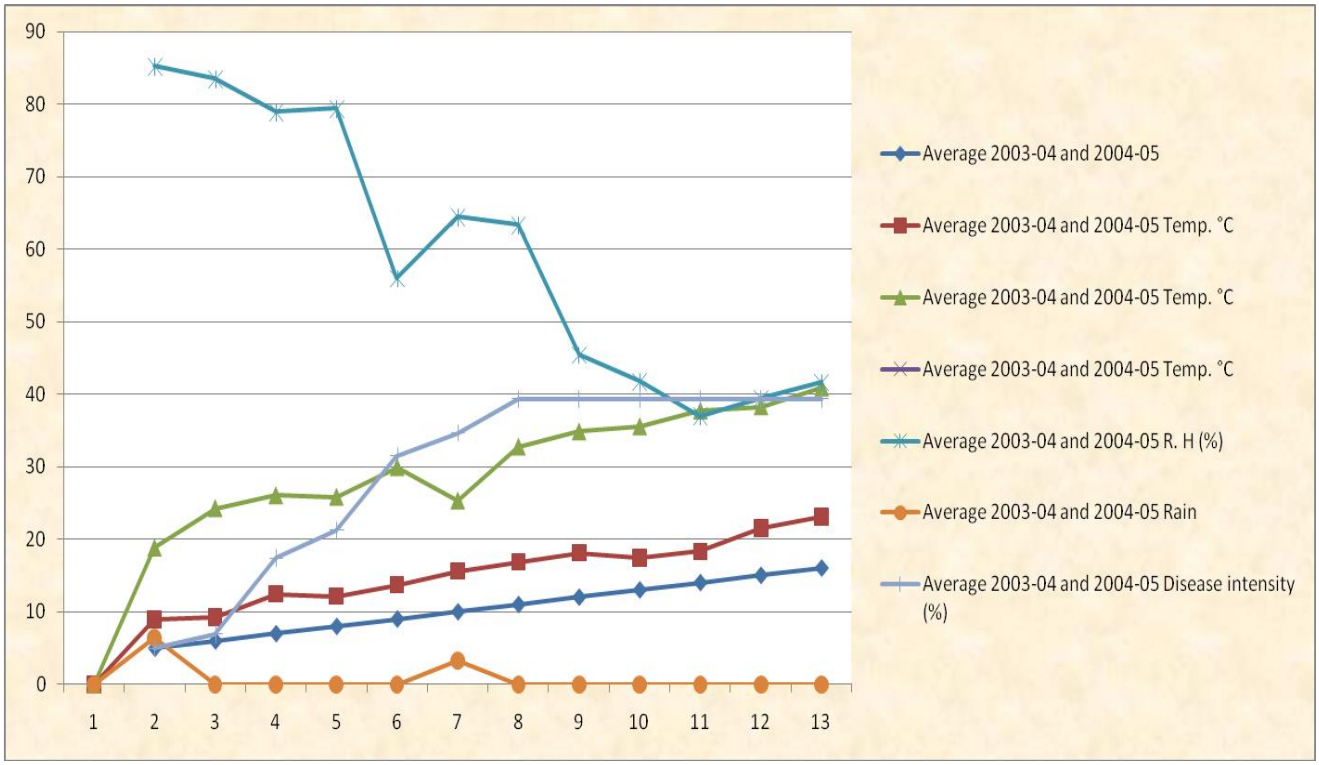
Date of sowing	disease intensity%		yield (q/ha)	
	2003-04	2004-05	2003-04	2004-05
1 October	40.50	38.20	108.90	110.20
16 October	36.50	37.60	112.60	110.80
1 November	35.80	32.40	94.00	96.00
16 November	32.60	29.80	85.00	87.00
1 December	30.00	29.50	64.80	65.30
C.D. at 5%	1.400	1.626	4.053	3.700
S.Em±	0.705	0.767	1.911	1.745

Table 4: Reaction of varieties /germplasm against stemphylium blight of garlic (*Stemphylium botryosum*) under natural condition during 2003 – 04 and 2004 -05.

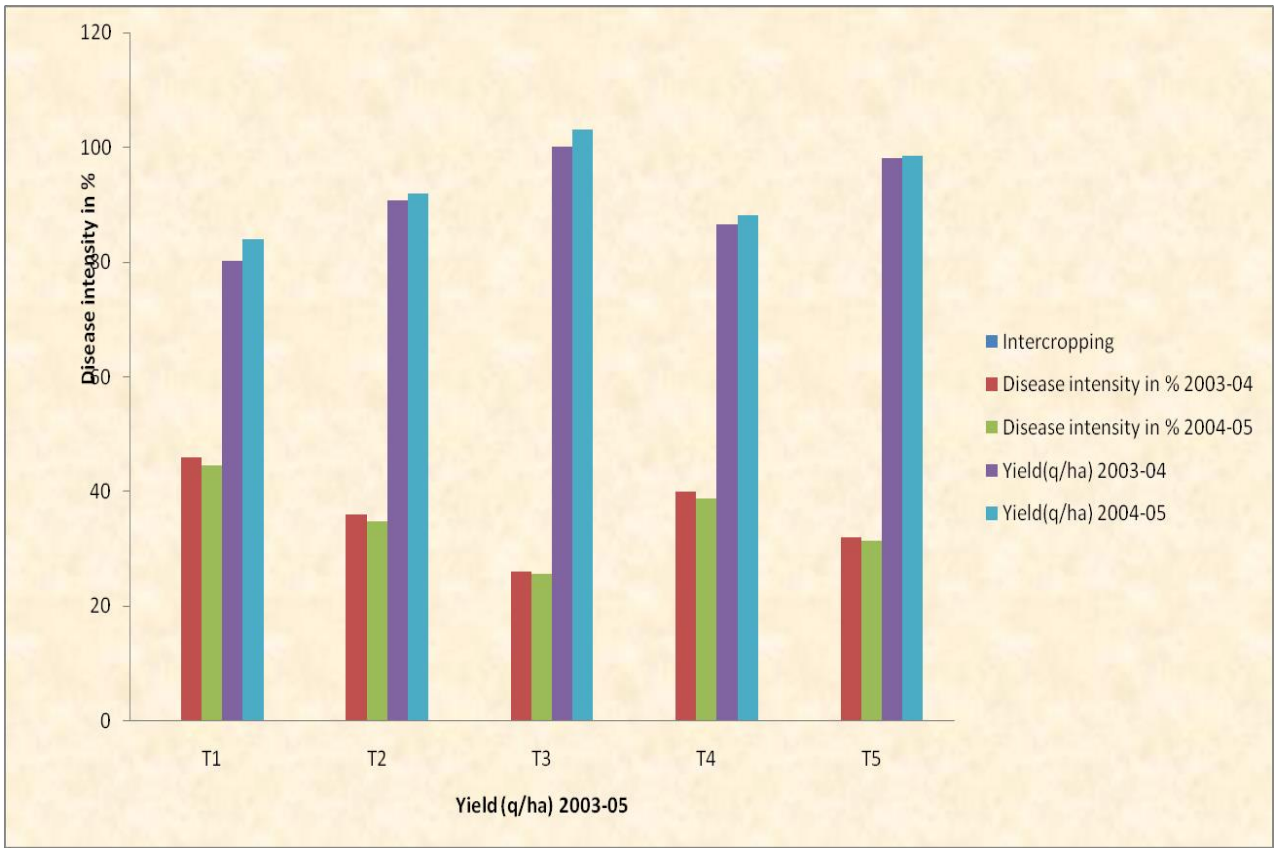
Numeric Value	Category	Varieties
0	Immune (Nil)	Nil
1	Resistant (R)(Nil)	Nil
2	Moderately Resistance (MR) (1-10 percent infection)	Nil
3	Moderately Resistance (MS) (11-25 percent infection)	DARL-52, JND-G-213, JND-G-219, SKA-U-151, S-9705, RAU-G-5
4	Susceptible (S) (26-50 percent infection)	AC-50, AC-200, G-200, G-313, G-176, KGS-2
5	Highly susceptible (HS) (Above 50 percent infection)	G-1, G-14, G-15, G-50, G-302, S-9701, C-33, S9703, S-9801, S-9507, S-2006, S-2007

Table 5: Effect of plant leaf extracts on colony growth of *S. botryosum in vitro*

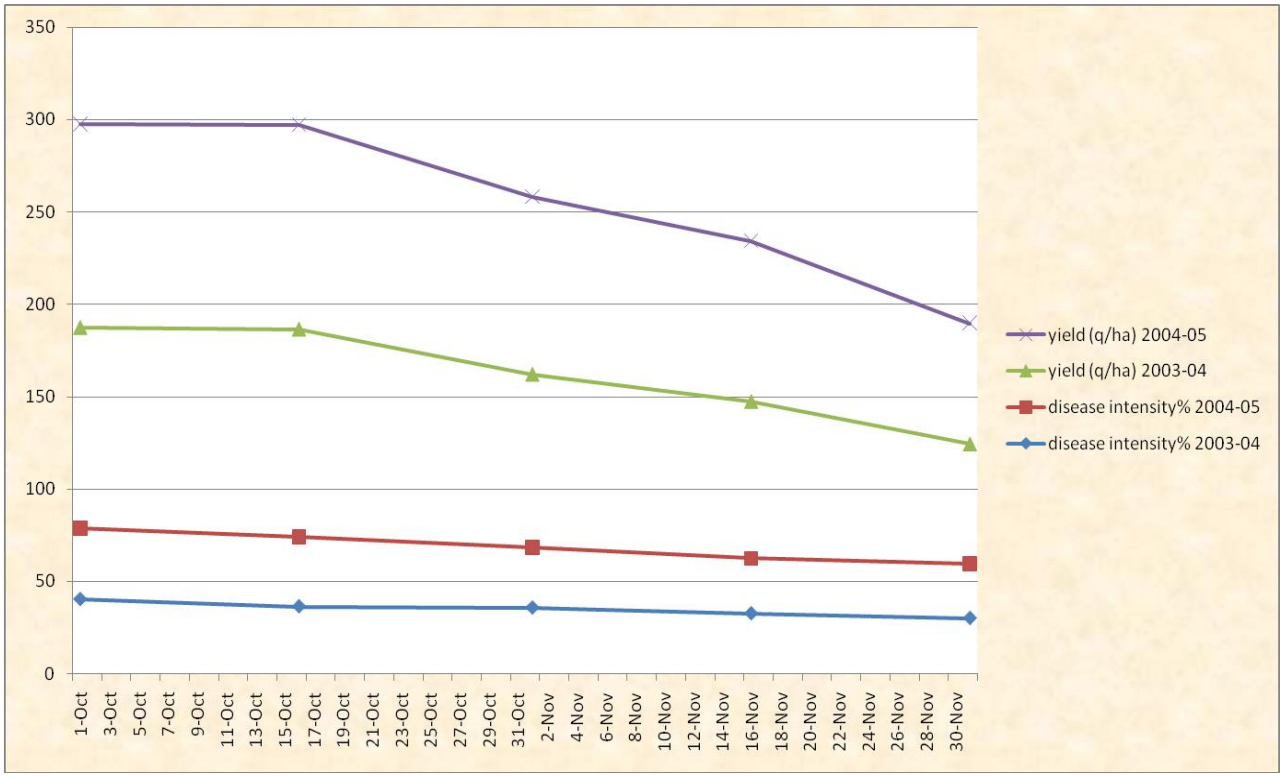
S. No.	Leaf extract (Treatment)	Average calony growth (mm)	Per cent inhibition over control
1.	Azadirachta indica	29.4	66.5
2.	Datura metal	31.2	64.5
3.	Lantana camana	34.8	64.5
4.	Parthnium hysterophores	52.0	40.8
5.	Ocium sp.	63.5	27.7
6.	*Argimone mexicana*	68.6	2.9
7	Control	87.8	-
CD at 5%		2.57	-
SE ±		6.53	-



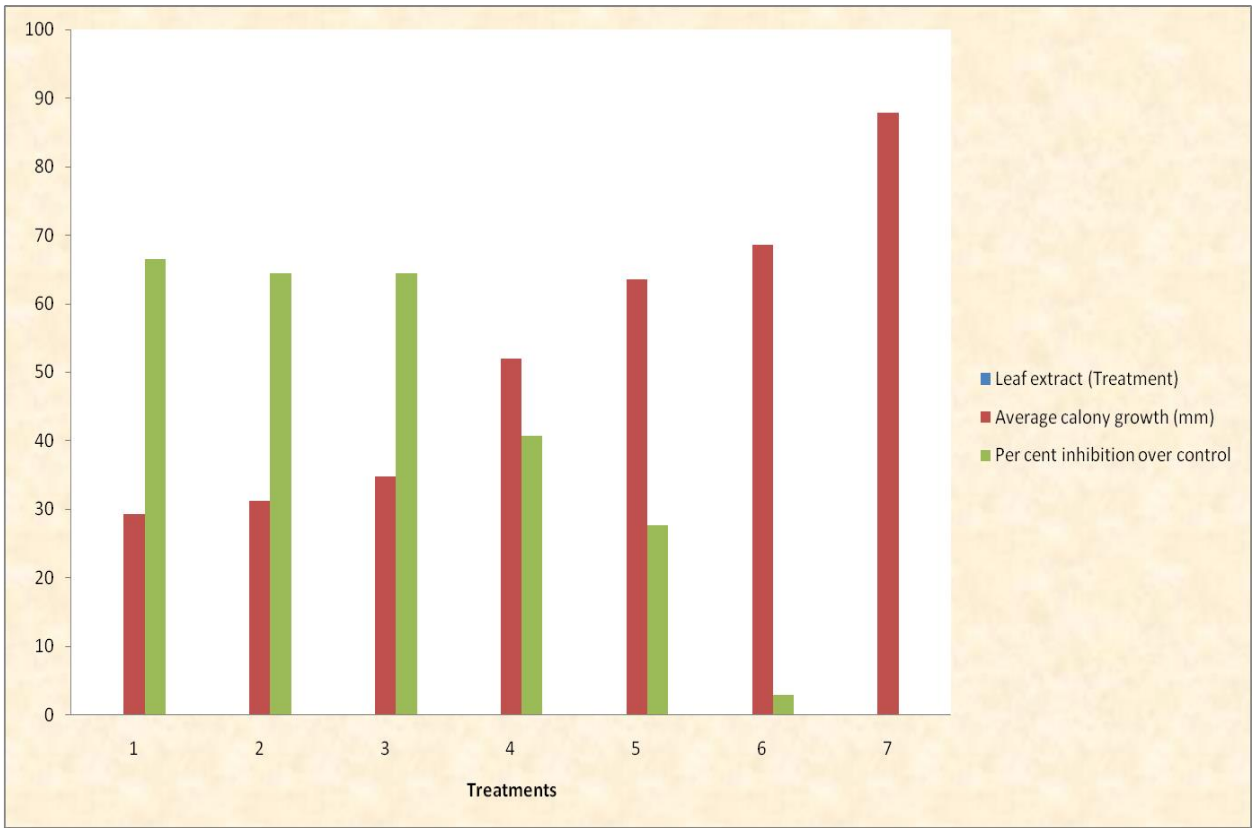
Graph 1: Effect of Atmospheric factors (Temperature, Relative humidity. & Rainfall) on disease development under natural condition during 2003-04 and 2004-05



Graph 2: Effect of Intercropping of garlic with carrot against



Graph 3: Effect of Alternate date of sowing on disease Intensity & yield of garlic



Graph 4: Effect of plant leaf extracts on colony growth of *S. botryosum in vitro*

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