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Jitendra Kumar Meena
Assistant Professor, Dolphin PG College of Biomedical & Natural Sciences, Dehradun, Uttarakhand, India

Anuj Gupta
Assistant Professor, Department of Agriculture Dolphin PG College of Biomedical & Natural Sciences, Dehradun, Uttarakhand, India

BP Chamola
Assistant Professor, Department of Forestry and Natural Resource Management H.N.B. Garhwal Central University, Srinagar, India

NC Pant
Assistant Professor (Biochemistry), Sri Karan Narendra Agriculture University, Jobner, Jaipur, Rajasthan, India

Corresponding Author:
Jitendra Kumar Meena
Assistant Professor, Dolphin PG College of Biomedical & Natural Sciences, Dehradun, Uttarakhand, India

Studies of insect and disease incidences in French bean genotypes under net-house conditions

Jitendra Kumar Meena, Anuj Gupta, BP Chamola and NC Pant

Abstract
Twenty green bean varieties (*Phaseolus vulgaris* L.) were evaluated at Vegetable Research Farm, Department of Vegetable Crops, Punjab Agricultural University, Ludhiana from October to March in net-house and in open field conditions during the year 2008-09 and 2009-10. After 50-70 days of growth, the varieties were assessed for pest infestation, disease tolerance and growth characteristics. Genotypes Contender, FB-18 and DWP-FB-53 showed pest infestation and disease problem, where as resistance against insects and disease was observed in Falguni, Seville, Aperna, Cosmo, 504-64-C, FB-3, FB-1, FB-5, FB-6, FB-18 and FB-19 genotypes. There were significant differences among all surviving genotypes with respect to the total number of pods per plant, weight of pods per plant and pod length. Harvest quality of the genotypes was also evaluated and pest infestation contributed significantly to the low yields recorded for the green bean genotypes under the current study. The poor performance of the bean varieties could be attributed to the prevalence of pest and disease problems in the field. Results indicate that green bean cultivation is possible under net-house conditions, but with proper pest and disease management apart from use of resistant genotypes to important diseases of green bean such as brown rust.

Keywords: French bean, net house, bean common mosaic virus and aphid

Introduction
French bean (*Phaseolus vulgaris* L.) belongs to the family Fabaceae and it is native of South America. French bean commonly known as kidney bean or snap been or fine bean is one of the important vegetable crop among legumes. It was domesticated in Mexico, Peru and Colombia about 8000 years ago. French bean has evolved from wild growing vine distributed in the high lands of Middle-America and Andes. These two domestications, led to two groups of cultivars with contrasting agronomic characteristics. During this evolution, some marked changes has affected this plant from climbing to dwarf type which has taken place both in the middle American and Andean domestication centres as reported by [9]. It is widely cultivated in tropics, sub tropics and temperate regions. In India, pulses account for about one fifth of the total area under food grains and contribute to about one fifth of the total food grain production with the total area under pulses being 23.85 m ha and production of 14.60 m tones (Anon., 2009). Among the pulses, raj mash is one of the high potential pulse crops with a yielding potential of 18 to 20 q per ha. It is grown for tender green pods for fresh consumption as well as for dry seeds which are used as pulse. This vegetable not only plays a vital role in nourishment of human population, but also improves soil fertility to a greater extent by virtue of being highly nitrogen fixing crop. 100 g green pods contain 1.7 g protein, 0.1 g fat, 4.5 g carbohydrate, 1.8 g fibre and are also rich in minerals and vitamins. It has some medicinal properties in control of diabetes, cardiac problems and natural cure for bladder burn. It has both carminative and reparative properties against constipation and diarrhea as reported by [2]. In India, it is mainly grown in Himachal Pradesh, Uttar Pradesh, Bihar, Gujarat, Madhya Pradesh, Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu.

French bean fetches premium price in market as compared to other vegetables and is a popular vegetable grown under irrigated conditions almost throughout the year. It is gaining lot of importance due to its short duration and high production potential as well as its high nutritive value. French bean is a tender warm season vegetable which cannot tolerate frost, high temperature and rainfall. Its seeds do not germinate below 15 °C and a most favourable soil temperature for its seed germination ranged from 18-24 °C. A mean air temperature of 20-25 °C is optimum for its growth and high pod yield. Extreme high temperature interferes with pod

filling. When sowing of French bean is done in September-October under open field conditions in Punjab there is a severe mortality of plants due to *fusarium* wilt at germination stage.

Moreover, occurrence of frost coupled with low temperature during the month of December-January, causes mortality of plant. Hence extreme low and high temperature are the limiting factors for successful cultivation of French bean under open field conditions in Punjab. To overcome these environment factor, protected cultivation particularly net-house cultivation is the best alternative which offers distinct advantages of earliness, high productivity, better quality and pesticide residue free produce besides higher returns to growers [11]. While studying the cultivation of capsicum in net-house reported that fruits are more uniform, larger in size and mature one month earlier to conventional cultivation. So, net-house cultivation of C*apsicum*, Tomato and Brinjal in net-house has been recommended by Punjab Agricultural University, Ludhiana. Leguminous plant species are susceptible to many biotic stresses, including attacks by many different insect pests and diseases. Pest and disease problems present major constraints to agricultural productivity of the common bean, particularly in the tropics. Worldwide, yield losses due to insect pests alone have been estimated to be from 35% to 100% annually [11]. Pest problems prohibiting more extensive production of legume crops include such diseases as brown rust, powdery mildew and insect pests such as aphids, caterpillars, leafhoppers and whiteflies. These pest and disease problems can be controlled through proper management.

The use of resistant varieties provides a practical and less costly method of pest and disease control in the green bean. The introduction and evaluation of high yielding legume crops resistant to pests and diseases is essential to the exploitation of this crop's potential [7]. The best approach to controlling pest problems in beans is through an integrated pest management system, combining several techniques known to be effective in keeping pest problems to minimum. These techniques include the use of resistant varieties, natural predators, organic pesticides, bio pesticides, crop rotation, and other cultural practices, such as the removal of debris from the field. This study is necessary as attempts are made to identify high yielding bean varieties with good tolerance to pests and diseases. Therefore, the present investigation has been planned on French bean under net-house conditions to evaluate insect and disease incidences in French bean genotypes under Net-House conditions

2. Materials and Methods

2.1 Plant materials

Twenty genotypes of French bean (Table 1) obtained from different sources (Public sector and private sector) were collected.

Table 1: French bean genotypes and their sources

S. No.	Genotypes	Source
1	Falguni	Seminis Seeds
2	Seville	AVRDC, Taiwan
3	Aperna	AVRDC, Taiwan
4	504-64C	AVRDC, Taiwan
5	Cosmo	Suttind Seeds
6	DPP-BSS-1	UAS, Dharwad
7	DWP-FB-1	UAS, Dharwad
8	DWP-FB-53	UAS, Dharwad
9	DWP-FB-57	UAS, Dharwad
10	IIHR –909	IIHR, Bangalore
11	FB-3	SKUAST, J$K
12	FB-4	SKUAST, J$K
13	FB-5	SKUAST, J$K
14	FB-6	SKUAST, J$K
15	FB-16	TNAU, Coimbatore
16	FB-17	TNAU, Coimbatore
17	FB-18	GBPUAT, Pant nagar, UK
18	FB-19	GBPUAT, Pant nagar, UK
19	FB-20	GBPUAT, Pant nagar, UK
	Contender (C)	IARI, Katrain, H.P.

These varieties were evaluated at Vegetable Research Farm, Department of Vegetable Crops, Punjab Agricultural University, Ludhiana from October to March in the net-house and in the open field conditions during the year 2008-09 and 2009-10. The experiment was laid out in a Randomized Complete Block Design with three replications. Genetically pure seeds of each genotype was sown in a 2.5 m long row at 30 cm spacing between paired rows on a 90 cm raised bed (45 cm bed top and 45 cm furrow). The plant to plant spacing was kept 10 cm and recommended cultural practices were followed to raise a uniform healthy crop.

2.2 Insect-pest incidence mite infestation (%)

The incidence of mites viz., *Tetranychus urticae* Koch. was recorded up to end march April, 2008-9, and 2009-10 at fifteen days interval. During each observation period two leaves from top middle and bottom part of the canopy of randomly selected five plants were rated by using the following 0-4 scale and the number of mites on the leaves recorded with the help of 10× hand lens. Mite feeding caused yellowish-white symptoms on the test plants, which were grouped into the following 5 grades [5]

Table 2: Mite incidence was recorded by following 0- 4 grade

Grade	Symptoms
0	Leaf free of any symptoms (Healthy leaf)
1	25% leaf area showing yellowish-white symptoms
2	50% leaf area showing yellowish-white symptoms, with slight webbing
3	75% leaf area showing yellowish-white symptoms, with large webbing
4	Whole leaf area showing yellowish-white symptoms, dense webbing and leaf fall.

2.3 Aphid incidence (%)

The per cent incidence of aphid was calculated using the following formula as under:

$$Percentage\ Damage = \frac{Number of plants\ infested}{Number of plants\ observed} \times 100$$

2.4 Disease incidence (Under natural epiphytotic conditions)

Sclerotinia white rot incidence (%)

The incidence of *Sclerotinia* white rot was calculated using the following formula as under:

$$Percentage\ Damage = \frac{Number of plants\ infected}{Number of plants\ observed} \times 100$$

Anthracnose incidence (%)

Survey and surveillance for anthracnose severity Anthracnose incidence was calculated using the formula as under:

$$Percentage\ Damage = \frac{Number of plants\ infected}{Number of plants\ observed} \times 100$$

The anthracnose incidence was recorded by following 0-9 scale.

Scale

Table 3: Anthracnose incidence was recorded by following 0-9 scale

Category	Description
0	No symptoms on leaves
1	Small pin-head size lesions covering 1% or less leaf area
3	Small pin-head size lesions covering 1-10% of leaf area
5	Lesions big but not coalescing, covering 11-25% of the leaf area
7	Lesions on leaves covering 26-50% of leaf area. Cankers on stem and pod infection
9	Lesions on leaves covering 51% or more of leaf area. Defoliation of leaves, deep cankers on stem and pods, blighting of plant occurs

2.5 Per cent disease index (PDI)

The intensity of the disease was recorded by scoring all the tagged ten plants in each treatment using 0 to 9 scales.

2.6 Bean common mosaic virus (BCMV)

Studies were undertaken to test the resistance of French bean germplasms against bean common mosaic virus disease. Field experiments were conducted during *rabi* 2008-9 and 2009-10 under net-house conditions at Vegetable Research Farm, Punjab Agricultural University, Ludhiana.

Per cent disease incidence was calculated by using the following formula:

$$Percentage\ Damage = \frac{Number of plants\ infected}{Number of plants\ observed} \times 100$$

The genotypes were later grouped into different categories based on 0-5 scale from immune to highly susceptible [1].

Table 4: Scale from immune to highly susceptible condition from 0 – 5 category

Scale	Category	Description
0	Immune	No plants showing symptoms
I	Resistant	1-5 per cent of plants showing symptoms
II	Moderately Resistant	5-15 per cent of plants showing symptoms
III	Moderately Susceptible	15-25 per cent of plants showing symptoms
IV	Susceptible	25-50 per cent of plants showing symptoms
V	Highly Susceptible	>50 per cent of plants showing symptoms

2.7 Statistical analysis

Mean value of each genotype in each replication for all the traits were subjected to statistical analysis as per randomized block design and the results were computed on the following parameters by [4].

3. Result and Discussion

3.1 Reaction to insect-pests and diseases

Table 5: Mite infestation

Varieties	Red Spider Mite rating		
	2008-09	2009-10	Pooled Mean
Falguni	0.06	0.04	0.05
Seville	0.10	0.25	0.17
Aperna	0.32	0.48	0.40
504-64C	0.50	0.75	0.62
Cosmo	0.20	0.32	0.26
DPP-BSS-1	0.50	0.95	0.72
DWP-FB-1	0.58	0.96	0.77
DWP-FB-53	1.12	1.50	1.31
DWP-FB-57	0.65	1.06	0.85
IIHR-909	0.72	0.95	0.83
FB-3	0.30	0.54	0.42
FB-4	0.28	0.40	0.34
FB-5	0.56	0.88	0.72
FB-6	0.48	0.65	0.56
FB-16	0.75	0.90	0.82
FB-17	0.85	1.08	0.96
FB-18	1.05	1.35	1.20

FB-19	0.65	0.12	0.38
FB-20	0.54	0.40	0.47
Contender (C)	0.75	1.06	0.90
Range	0.06-1.12	0.04-1.50	0.05-1.31

The rating of red spider mite varied 0.06-0.12 in 2008-09, 0.04-1.50 in 2009-10 and 0.05-1.31 in pooled mean. The low mite infestation with rating 0.00 -0.50 was observed in genotypes Falguni, Seville, Aperna, Cosmo, FB-3, FB-4, FB-6, FB-19 and FB-20 which were found resistant. Nine genotypes viz 504-64-C, DPP-BSS-1, DWP-FB-1, DWP-FB-57, IIHR-909, FB-5, FB-16, FB-17 and Contender were found moderately resistant to red spider mite with mean rating ranging from 0.6 – 1.0. Only two genotypes viz FB-18 and DWP-FB-53 were found moderately susceptible with mean rating ranging from 1.0 – 2.0. [10] Studied about incidence of spider mite [6]. Also revealed incidence of red spider mite, *Tetranychus* sp. was negligible throughout the crop season which is otherwise observed as a serious pest in the net-house. In the present study no aphid incidence was observed in the net-house. There was no appearance of *Sclerotinia* white rot incidence, whereas Anthracnose incidence was observed in the net-house

3.2 Reaction of bean common mosaic virus

Reaction of different French bean genotypes to Bean common mosaic virus.

Table 5: Reaction of different French bean genotypes to Bean common mosaic virus

Category	Scale	Genotypes
Immune	0	-
Resistant	1	Falguni, Seville, Aperna, 504-64-C, Cosmo, DWP FB-1, FB-5, FB-16, FB-18 and FB-19
Moderately Resistant	2	IIHR-909, FB-3, FB-4, FB-17 and FB-20
Moderately Susceptible	3	DPP-BSS-1, DWP-FB-53 and DWP-FB-57
Susceptible	4	Contender (C)

Out of twenty genotypes none was found to be immune to bean common mosaic virus. Some genotypes viz Falguni, Seville, Aperna, 504-64-C, Cosmo, DWP-FB-1, FB-5, FB-16,FB-18 and FB-19 were found resistant where as genotypes IIHR-909, FB-3, FB-4, FB-17 and FB-20 were found moderately resistant to bean common mosaic virus. However genotypes DPP-BSS-1, DWP-FB-53 and DWP-FB-57 were rated to be moderately susceptible and contender as susceptible to bean common mosaic virus [3]. studied the natural occurrence of eight viruses affecting cowpea in Iran, the summer 1999-2000, a survey for viruses infecting cowpea was conducted in five main cowpea cultivating provinces in Iran.

4. Conclusion

It would appear that in cultivating these leguminous crops, special attention must be paid to crop rotation, cropping history of the field, crop scheduling, to minimise the impact of pest and disease problems. For a successful cultivation of this crop, efforts must be made to ensure that pest management issues are dealt with properly. The findings of the present investigation clearly reveals that farmers should be encouraged to integrate chemical plus biological or chemical plus botanical pesticides in their spray regimes as they give reasonable yield and good benefit cost analysis. Further evaluation of integrating chemical plus biological pesticides with cultural practices in management of thrips must be done.

3. Field studies should be done to generate more information on how *Azadirachtin* can be successfully incorporated in spray regimes together with *M. anisopliae* ICIPE 69 and chemical pesticides.

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