

## **Influence of Single and Mixed Infections of Broad Bean Mottle Bromovirus and Bean Yellow Mosaic Potyvirus on Growth and Yield of Faba Bean (*Vicia faba* L.)**

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### **ABSTRACT**

In field trials with faba bean (*Vicia faba* L.) in the Sudan, inoculated with local isolates of broad bean mottle bromovirus (BBMV), bean yellow mosaic potyvirus (BYMV) or both, one month after sowing, induced 74, 47 and 82% reduction, respectively, in the shoot dry weight of cv. Silaim, and 74, 47 and 73% in that of cv. Hudeiba 72. When inoculated two months after sowing, these reductions were 43, 28 and 56%, respectively, in cv. Silaim and 49, 51 and 48% in cv. Hudeiba 72. Average number of pods and seeds per plant were also significantly reduced when the plants were inoculated one or two months after sowing. Similarly BBMV, BYMV and the mixed infection resulted in 73, 71 and 79% reduction, respectively, in seed yield of cv. Silaim, and 46, 42 and 69% in that of cv. Hudeiba 72 when inoculated one month after sowing. Inoculation two months after sowing also resulted in significant reduction in seed yield of both cultivars. No significant reduction in shoot dry weight or seed yield were obtained when the faba bean plants were inoculated three months after sowing.

**Key words :** Faba bean; Broad bean mottle bromovirus; Bean yellow mosaic potyvirus; Yield loss assessment.

### **INTRODUCTION**

Faba bean (*Vicia faba* L.) is the most important food grain legume in the Sudan. It is grown mainly in the northern areas and is consumed throughout the country. It is considered the main source of protein for the middle and low income groups.

Field-grown faba bean in the Sudan suffers from several diseases of which those caused by viruses are considered the most important. These include bean leaf roll luteovirus (BLRV), bean yellow mosaic potyvirus (BYMV) broad bean mottle bromovirus (BBMV), broad bean stain comovirus (BBSV), cucumber mosaic virus (CMV) and pea seed-borne mosaic virus (PSBMV) (Bos, 1980; Ahmed and Mills, 1985; Makkouk et al., 1988). BBMV and BYMV are the most prevalent viruses in the country (Ahmed and Hussein, 1989). However, no growth and yield of faba bean in the Sudan. As such information is needed to set priorities for research and in developing control strategies, we have now studied the effects of BBMV and BYMV in single or mixed infections on the growth and yield of faba bean.

## MATERIALS AND METHODS

Field experiments were conducted during the 1989/1990 and 1990/1991 growing seasons in isolated plots at the University Farm at Shambat. The effects of BBMV, BYMV, and mixed infections of both viruses on the growth and yield of faba bean cultivars, Silaim (large-seeded) and Hudeiba 72 (medium-seeded), were investigated in split plot designs of four replicates in which 48 plots were allocated to each cultivar at random and the plants in every 12 plots were inoculated with BBMV, BYMV, BBMV + BYMV or left uninoculated as controls. The plot size was 3.6 m x 3.2 m with 60 cm x 20 cm spacing. The seeds were sown during the first week of November at the rate of two seeds per hole. The four treatments applied were inoculations 1, 2 or 3 months after sowing or uninoculated control. The third inoculation coincided with the flowering period (January/February).

Pure freeze-dried Sudanese isolates of BBMV and BYMV, previously isolated and identified from faba bean, were propagated in faba bean plants. The field inoculations were as described by Ahmed (1986 a). Precautions taken to minimize the spread of viruses included; the use of isolated plots, sowing of virus-free seeds and frequent spraying with insecticides and rouging of plants suspected to be cross infected. The cultural practices were as recommended by the Agronomy Department, (Faculty of Agriculture, University of Khartoum). The incidence of virus infection was determined by visual observations. A destructive sampling procedure was followed to assess growth. Starting one week after inoculation, four plants were weekly selected randomly in each plot, cut at the soil surface and dried in the Unitherm oven at 80°C for 48 hours for shoot dry weight determination.

## RESULTS

The effects of virus infection on the shoot dry weight of the two faba bean cultivars when inoculated one month after sowing are shown in Figure 1. This shows a slight, but statistically insignificant, reduction in the shoot dry weight during the first two weeks after inoculation. However, statistically significant reductions ( $P=0.01$ ) occurred later. The average shoot dry weight reduction was 47, 74, and 82% in cv. Silaim as the result of BYMV, BBMV and the mixed infection, respectively. Similarly for cv. Hudeiba 72 slight, but insignificant, reduction in shoot dry weight occurred during the first two weeks but statistically significant reductions ( $P=0.01$ ) occurred later. The average shoot dry weight reduction was 47, 74, and 73%, respectively. Similarly, in plants inoculated two months after sowing the reduction was 29, 43, and 56% in cv. Silaim, respectively, and 51, 49, and 48% in cv. Hudeiba 72, respectively. These reductions were also statistically significant ( $P<0.05$ ). No significant reduction in shoot dry weights occurred when the plants were inoculated three months after sowing.

Table 1 shows that the infection of the two cultivars with BBMV, BYMV or both, one month after sowing, resulted in highly significant reduction in the average numbers of pods and seeds produced during the two growing seasons. The reduction was also significant when the infection took place two months after sowing. No significant reduction occurred in plants inoculated three months after sowing.

Inoculation with BBMV, BYMV or both one or two months after sowing significantly reduced the yield ( $P<0.05$ ) of both cultivars each season. During the 1989/90 season, BBMV, BYMV and the mixed infection, inoculated one month after sowing, induced 73, 71 and 79% reduction, respectively, in yield of cv. Silaim, and 46, 42 and 69%, reduction, respectively in yield of cv. Hudeiba 72 (Fig. 2). Moreover, significant reduction in the yield ( $P<0.05$ ) was obtained when the plants were inoculated two months after sowing. No yield reduction occurred when the plants were inoculated three months after sowing. Similar results were obtained in the 1990/1991 season (Fig. 3).

## DISCUSSION

The development and final yield of faba bean were severely affected by BBMV, BYMV alone and by mixed infection with both viruses. The biggest reduction in growth and yield were obtained when the plants were inoculated one month after sowing. In similar field

inoculation trials, Ahmed (1986 a, b) found that peanut stunt virus and alfalfa mosaic virus, when inoculated two weeks after emergence, each reduced the shoot dry weight of cv. Silaim by 89%. The present studies also show that BBMV, BYMV or the mixed infection of faba bean, one or two months after sowing, resulted in significant reduction in the number of pods and seeds produced. In Canada, Frowd and Bernier (1977) reported severe reduction in the shoot dry weight of faba bean as the result of BYMV infection. Field faba bean inoculated with a mild isolate of BYMV 5, 7 and 9 weeks after sowing, produced 59, 48 and 17% less yield than uninoculated plants, respectively. However, they obtained 96, 70 and 17% less yield, respectively, when they inoculated the faba bean plants with a severe isolate of BYMV. Similarly, Makkouk (1987) reported significant reduction in the yield of faba bean caused by BBYM, BBMV or both in Syria. The earlier the infection the more loss in yield. Moreover, the mixed infection due to BBMV and BYMV caused the most severe damage on the plants and the highest reduction in yield.

Unlike the results of our study, Chamberlain (1936) reported that BYMV infection had little effect on the yield of faba bean in New Zealand. Kaiser (1973) reported 56, 48 and 77% reduction in faba bean in Iran when the plants were inoculated with BYMV before, during or after flowering. The differences between our results and those reported by Chamberlain and Kaiser could be due to the virus strain, the faba bean cultivars or the growth stage of the plants when the infection occurred. However, the results of our studies have clearly shown the importance of BBMV and BYMV infection of faba bean in the Sudan and indicated the need for effective control measures.

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Table 1. The effects of BYMV and BBMV and mixed infection on the average number of pods and seed production of two cultivars of faba bean inoculated 1 or 2 months after sowing (average of two seasons).

Cultivar	Treatment	Average pod No./plant (% reduction)		Average seed No./plant (% reduction)	
		Inoc. 1 Mo. after sowing	Inoc. 2 Mo. after sowing	Inoc. 1 Mo. after sowing	Inoc. 2 Mo. after sowing
Silaim	BYMV	4.7** (50)	5.6* (34)	10.2** (50)	12.0* (37)
	BBMV	3.2** (67)	6.6* (24)	5.8** (71)	24.8* (22)
	BYMV+BBMV	2.4** (75)	4.9* (43)	4.2** (79)	9.8* (48)
	Control	9.5	8.6	20.3	19.0
Hudeiba	BYMV	10.2* (30)	10.8* (14)	26.3** (30)	27.9* (18)
	BBMV	8.1** (45)	10.5* (16)	19.1** (49)	26.8* (22)
	BYMV+BBMV	5.5** (62)	9.8* (21)	12.5** (67)	24.5* (28)
	Control	14.5	12.5	37.6	34.2

\* Significantly different from control at P = 0.05

\*\* Significantly different from control at P = 0.01

Values between brackets represent % reduction as compared to healthy plants.

Fig. 1. The effects of BBMV, BYMV or both on the shoot dry weight of two faba bean cultivars A-Silaim and B-Hudeiba.

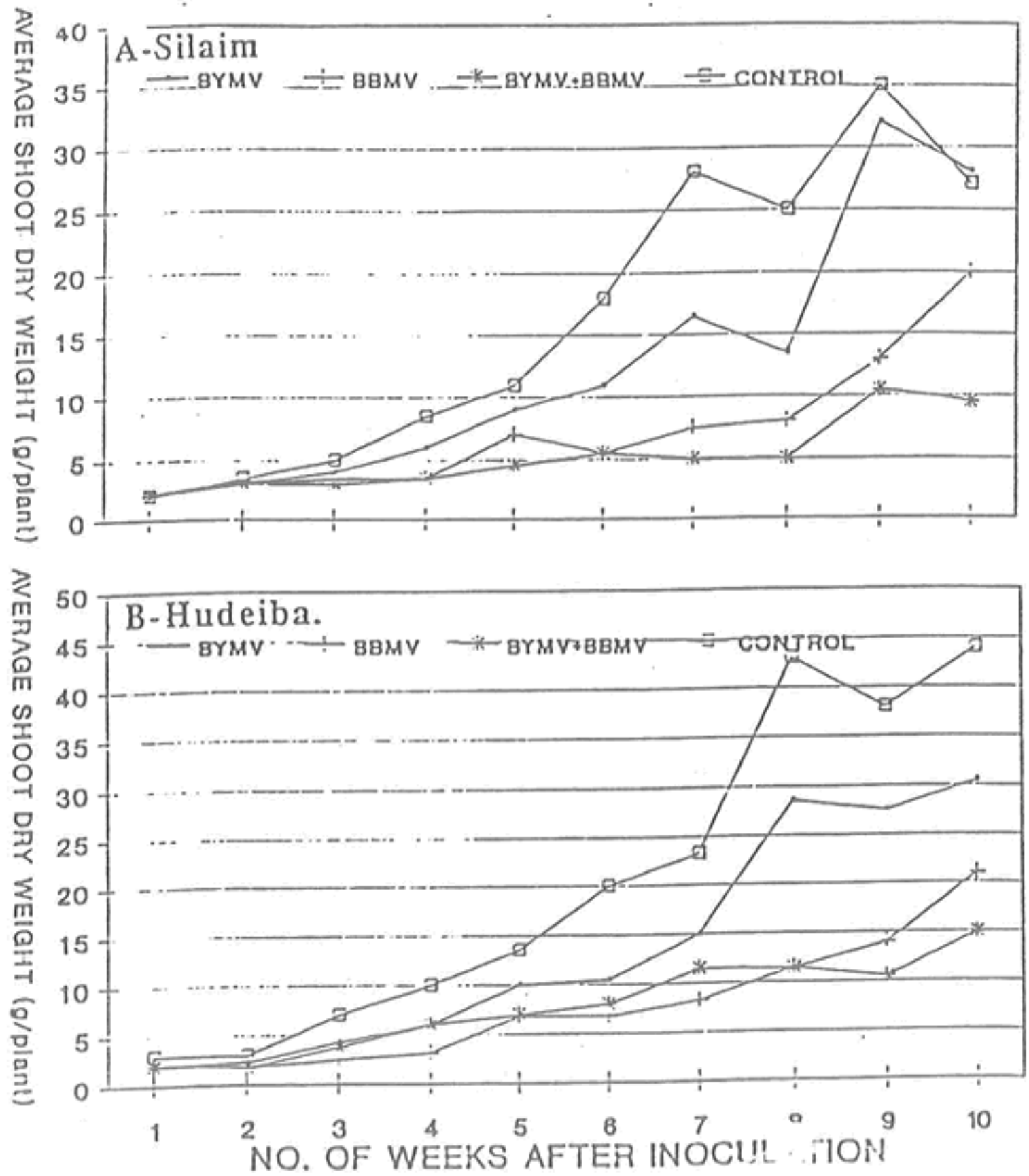
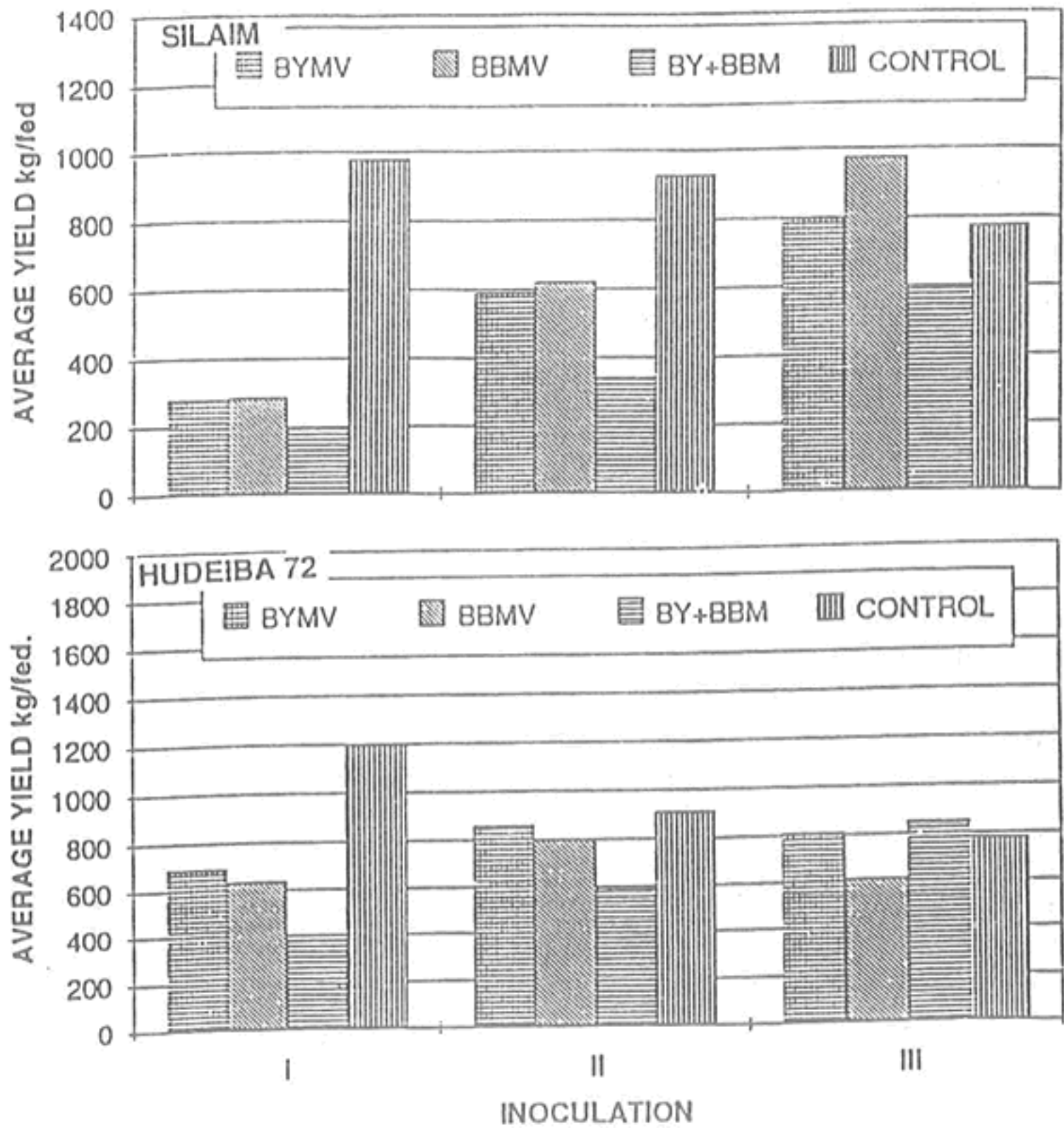


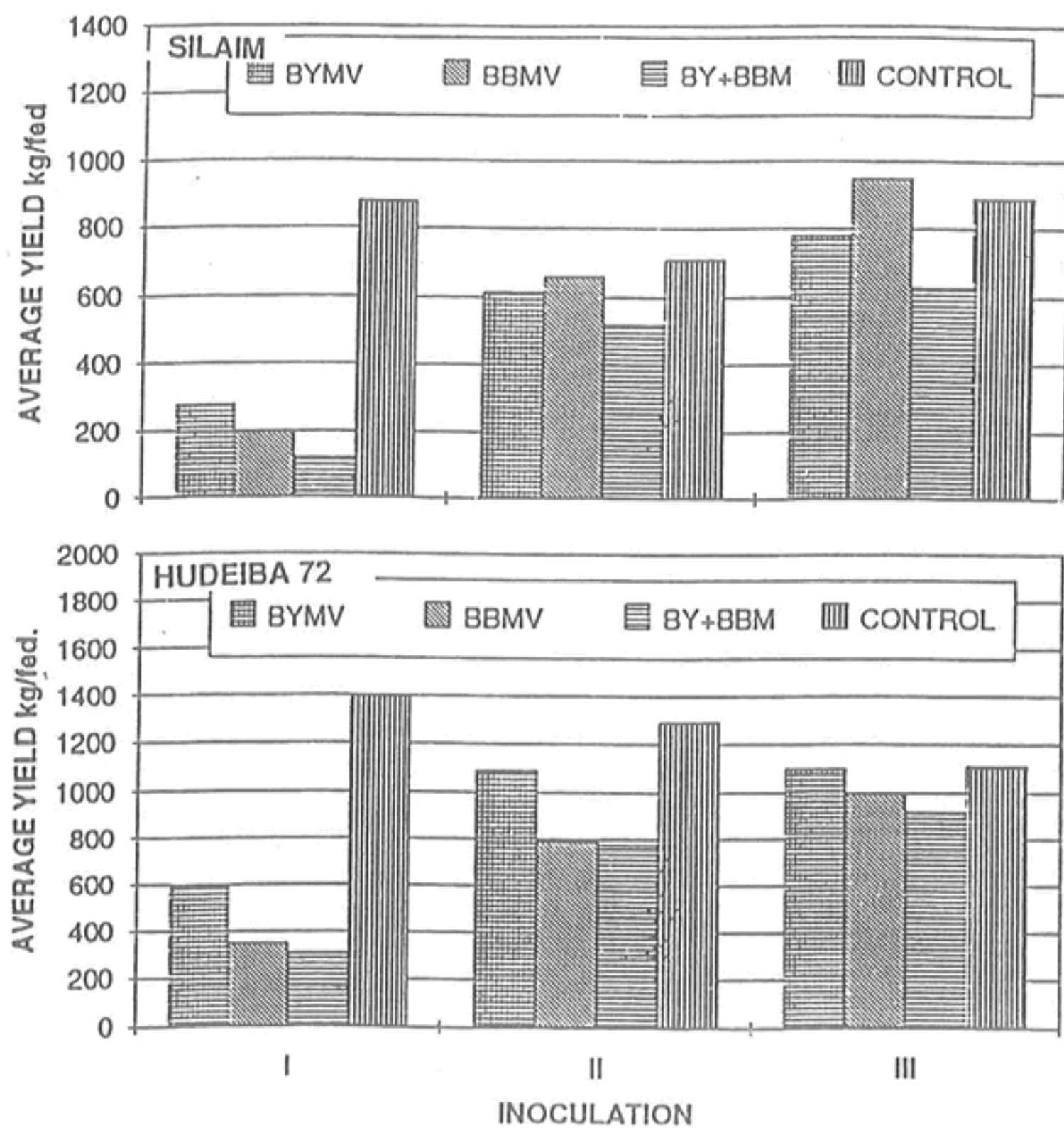
Fig. 2. Average seed yield per feddan\* of the faba bean cultivars Silaim and Hudeiba inoculated with BYMV, BBMV, and BYMV + BBMV in 1989/90 season.



\* 1 feddan = 1.038 acre = 0.42 ha.



Fig. 3. Average seed yield per feddan\* of the faba bean cultivars Silaim and Hudeiba inoculated with BYMV, BBMV, and BYMV + BBMV in 1990/91 season.



\* 1 feddan = 1.038 acre = 0.42 ha.

## تأثير الإصابة بفيروس تبرقش الفول وفيروس موزاييك الفاصولياء الأصفر أو بالفيروسين معا على نمو وإنتاج الفول .

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### ملخص :

دلت التجارب الحقلية التي أجريت لدراسة تأثير الإصابة الميكانيكية لعينتين من الفول بعد شهر من الزراعة بعزلات سودانية لكل من فيروس تبرقش الفول (BBMV) وفيروس موزاييك الفاصولياء الأصفر (BYMV) أو الفيروسين معا إلى نقص في الوزن الجاف للمجموع الخضري للعينة سليم بنسبة ٧٤ ، ٤٧ و ٨٢٪ ، على التوالي . كما أدت تلك الإصابة إلى نقص في الوزن الجاف للمجموع الخضري للعينة حديثة ٧٢٪ بنسبة ٤٩ ، ٥١ و ٤٨٪ على التوالي . كما أدت إصابة العينتين بتلك الفيروسات إلى نقص في معدل تكوين القرون وإنتاج البذور . أدت الإصابة ، بعد شهر من الزراعة ، بفيروس تبرقش الفول أو فيروس موزاييك الفاصولياء الأصفر أو بالفيروسين معا إلى نقص في إنتاج بذور العينة سليم بنسبة ٧٣ ، ٧١ ، ٧٩٪ ، على التوالي ، وإلى نقص في إنتاج بذور العينة حديثة ٧٢ بنسبة ٤٦ ، ٤٢ ، ٦٩٪ ، على التوالي ، وأدت الإصابة بتلك الفيروسات بعد شهرين من الزراعة إلى نقص معنوي في إنتاج العينتين . لم تدل الدراسة على نقص في الوزن الجاف للمجموع الخضري أو في إنتاج البذور عن إصابة نباتات الفول بعد ثلاث شهور من الزراعة .

كلمات مفتاحية : فول ، فيروس تبرقش الفول ، فيروس موزاييك الفاصولياء الأصفر ، النمو والإنتاج .