



Integrated management of chickpea and lentil viruses and their vectors in North Shewa, Ethiopia



Beyene Bitew¹, Fekadu Tewolde¹, Bereket Ali¹, Aleme Belete¹,
Alemenew Fantaye¹, Yifru Worku¹, Safaa G. Kumari² and Seid A. Kemal³

*Debre Birhan Agricultural Research Center, Ethiopia; (2) International Center for Agricultural Research in the Dry Areas (ICARDA),
Terbol Station, Zable, Lebanon; (3) ICARDA, Rabat, Morocco.*

ABSTRACT

Lentil and chickpea are the most important cool season legume crops grown in cereal based cropping system in the mid highlands central Ethiopia. Productivity of both crops is affected by several biotic factors such as pod borers, aphids, wilt/root rot, foliar diseases, and viruses. Most plant viruses are transmitted by many aphid species and thus management of insect vectors is one of the main options for controlling viral diseases. On-farm trials were conducted at Enewary, North Shewa in 2022 main cropping season to identify best options for the management of emerging lentil and chickpea virus diseases and their aphid vectors. One lentil (Derso) and one chickpea (Mastewal) varieties, two insecticides [Dimethoate (Dimeto 40% E.C) and Selecron 720 EC (a.i. 720g/L PROFENOPHOS)] sprayed three times during the season, and four sowing dates were used as treatments. Field observations during the growing season showed that reddening and yellowing were the major virus symptoms recorded on lentil whereas reddening virus symptoms was recorded on chickpea. Spraying insecticides significantly minimized aphid populations and reduced virus symptoms incidence in lentil. Highest lentil biomass and grain yield was recorded for early sowing date combined with insecticide sprays. The results obtained indicated that the management of viruses and aphid vectors can be achieved through adjusting sowing date for lentil and chickpea crops.

INTRODUCTION

Lentil (*Lens culinaris* Medik.) and chickpea (*Cicer arietinum* L.) are the most important food crops grown in many countries. In Ethiopia, chickpea and lentil are important cool season food legumes both in area coverage and production next to faba bean, field pea and grass pea (CSA, 2022). Ethiopia is considered as a center of diversity for lentil, and it is the largest producer, consumer, and exporter of chickpea in Africa and shares 4.5% of global chickpea market (Gemechu *et al.*, 2016). Ethiopia ranks first both in terms of lentil and chickpea area coverage and production in Africa (FAOSTAT, 2023). The yield potential of chickpea is as high as 6 t ha⁻¹ (Agrawal and Kamakura, 1995), but the productivity of chickpea in Ethiopia is very low (2 t ha⁻¹) (CSA, 2022). Lentil and chickpea are valuable source of protein, income (local consumption and foreign exchange), serve as rotational crops and enhances cereal yield, play a significant role in soil fertility restoration. Despite multiple benefits, production and productivity of lentil and chickpea is declining over time due to different biotic and abiotic factors.

The biotic stresses are foliar and root diseases, field and storage insects, and non-parasitic and parasitic weeds and represent important production constraints that contributed to a significant crop yield loss. In addition, lack of improved varieties, soil acidity, deficiency of soil nutrients, low external inputs with poor agronomic practices used by farmers, drought and frost are also major abiotic stresses. Viral diseases have recently become major production constraints in lentil and chickpea production area of the country particularly in central part of Ethiopia and north Shewa (Ademe *et al.*, 2023; Kumari *et al.*, 2019). Hence, field experiments were initiated to identify the best virus management practices to reduce biomass and seed yield losses.

METHODOLOGY

Study area

The experiment was conducted at Enewary Research Site (altitude of 2666 m above sea level and latitude: 9° 25' 06" and longitude: 39° 10' 40") in 2022/23 main cropping season.

Treatments and experimental design

- One lentil variety "Derso (F P-88- 114 -02-AK- 41)" and one desi chickpea variety "Mastewal (ICCV-92006)".
- Four sowing dates (7 days interval and first sowing date was done on July 30, 2022 for lentil and August 18, 2022 for chickpea).
- Two foliar insecticides: Dimethoate (Dimeto 40% E.C) and Selecron 720 EC (Profenofos, 720 g/l).
- The field experiments were carried out using randomized complete block design with four replications using factorial arrangement.

- The plot size was 3 m x 3.6 m (10.8 m²), with seeding rate of 80 kg/ha for lentil and 135 kg/ha for chickpea. Other recommended agronomic practices were applied for the two crops.
- The two insecticides were applied as soon as aphids were observed on plants and a total of three sprays were applied. The rate of insecticides used were applied based on the manufacturers' recommendations.
- Data such as numbers of aphids on lentil before and after spraying, and virus incidence (%) on lentil and chickpea were recorded based on symptoms observed (chlorosis, stunting, yellowing, reddening, curling and mosaic/mottling). Biomass and grain yield was measured from lentil trials since most chickpea plants were killed by wilt/root rot in the late growth stage of the crop.

RESULTS

Lentil

- Reddening and yellowing symptoms were the major symptoms of virus infection recorded in all plots during the season (Figs. 1 and 2). The highest rate of reddening symptoms (53%) was recorded on unsprayed plot for the 3rd sowing date and the lowest (21%) was recorded on plots sprayed by Selecron for the 3rd sowing date. The highest rate of yellowing symptoms (19%) was recorded on unsprayed plot for the 2nd and 3rd sowing dates (Fig. 2).
- Spraying insecticides minimized aphid population in the sprayed plots (Fig. 3) and low virus symptoms incidence were recorded in sprayed plots compared with unsprayed plots (Fig. 2). The two insecticides did not show differences in their effectiveness to manage the viruses and their aphids' vectors (Figs. 2 and 3).
- The highest biomass yield (6.6 t/ha) was obtained from 1st sowing date sprayed with Selecron and 2nd sowing date/sprayed with Dimethoate, respectively (Figure 4-A), whereas the lowest (2.67 t ha⁻¹) was obtained for the 4th sowing date/unsprayed plots (Figure 4-A).
- The highest grain yield (2.6t/ha) was obtained from 1st sowing date sprayed with Selecron, whereas the lowest (1.2 t/ha) was obtained from 4th sowing date and not treated with insecticides (Figure 4-B).
- The results obtained indicated that management of vectors and adjusting sowing date can minimize virus incidence and increase biological yield. The finding should be validated on farmers' fields under farmer field condition. Seed treatment pesticides will be tested in 2024/25 cropping season.



Figure 1. Lentil and chickpea field experiments in 2022/23 main cropping season, Enewary Research Site, north Shewa, Ethiopia.

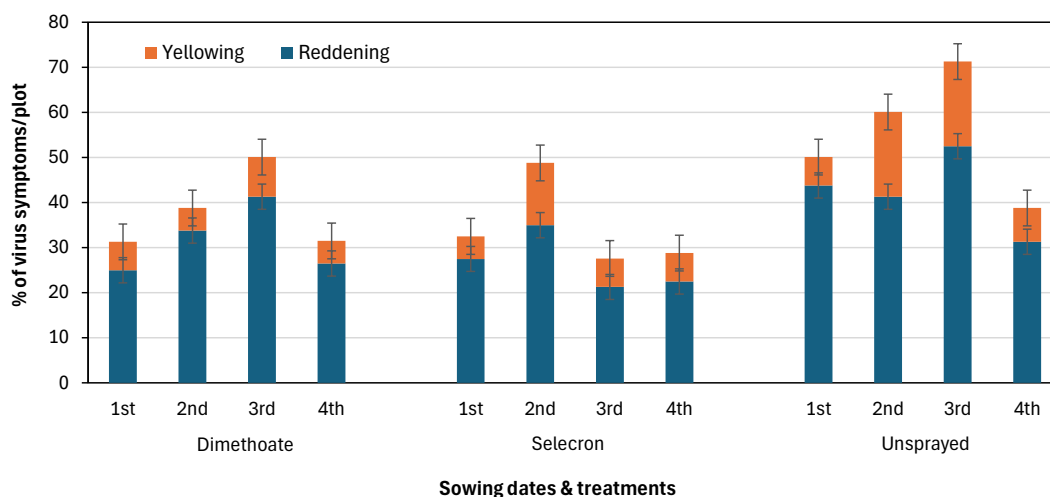


Figure 2. Virus symptoms (reddening and yellowing) on lentil in 2022/23 main cropping season, Enewary, north Shewa, Ethiopia.

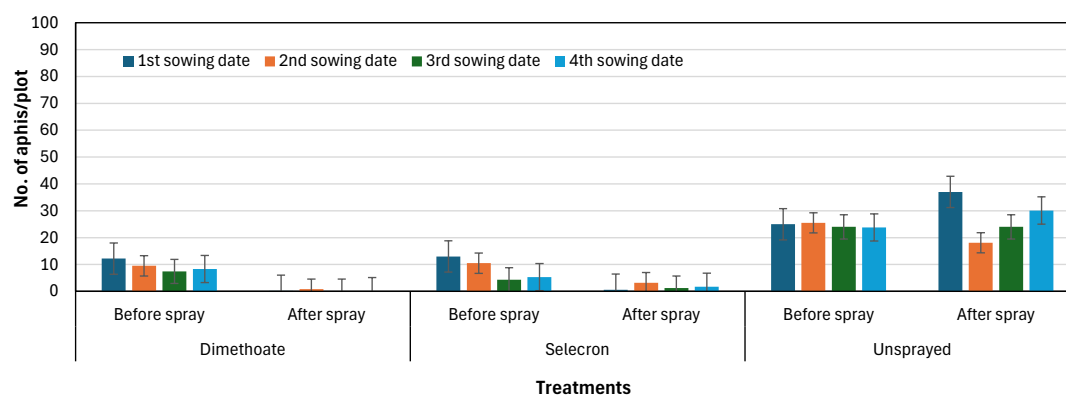


Figure 3. Number of aphids before and after insecticide sprays on lentil in 2022/23 main cropping season, Enewary, north Shewa, Ethiopia.

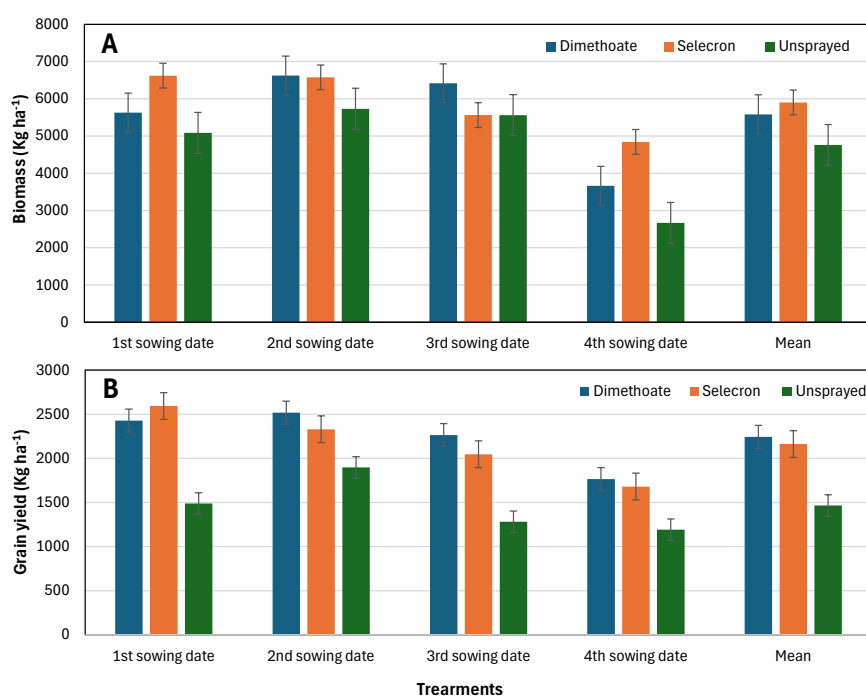


Figure 4. Biomass (A) and grain yield (B) of lentil, in 2022/2023 main cropping season, Enewary, north Shewa, Ethiopia

Chickpea

- The virus incidence in chickpea plots was very low (<10%) and only reddening symptoms were recorded (Fig. 5) and spraying with both insecticides reduced the % of reddening virus symptoms on all sowing dates compared to unsprayed plots (Fig. 5).
- Due to the high wilt/root rot and very high moisture stress, it was not possible to count the aphids and measure the biomass and grain yield.

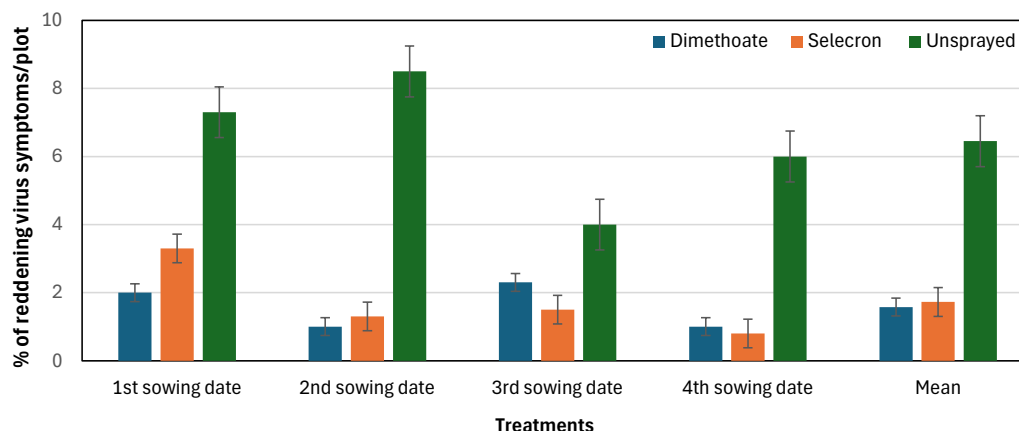


Figure 5. Virus reddening symptoms (A) 2022/23 cropping season, Enewary, north Shewa, Ethiopia

RECOMMENDATIONS

- Viruses transmitted by aphids caused significant damage to lentil and chickpea crops in Ethiopia.
- The initial implemented IPM strategies in Ethiopia, including early planting time and foliar spraying with insecticides, proved effective in reducing virus symptoms on both lentil and chickpea, and increase lentil productivity.
- Since wilt/root rot is a major problem for chickpea in Ethiopia, it is recommended to add another option to control wilt in the next growing season (e.g. seed dressing with fungicides). In addition, it would be useful to test seed-dressing insecticides to control viruses and their vectors.

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