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Faba bean seed source trial, Liverpool Plains Field Station, Breeza 2021

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Key findings

- Large differences in yield potential were found among farmer-grown faba bean seedlots.
- The *Bean yellow mosaic virus* epidemic in northern faba bean crops during 2020 did not result in significant levels of virus seed transmission, but seed harvested from severely infected paddocks showed generally less growth vigour, resulting in lower yields.
- Early season normalized difference vegetation index readings correlated significantly with plant emergence and yield.

Key words 2021, *Bean yellow mosaic virus*, Breeza, establishment, faba bean, NDVI, seed, seedling, vigour, yield

Introduction

Most seed for sowing faba bean and other pulses in NSW is grown on-farm. Seed is regularly tested for germination and the presence of seed-borne diseases, but rarely for other traits such as seedling vigour. Seedling vigour can have a major effect on crop establishment and can be critical to yield, particularly in stressful plant growing environments.

After 2 years of severe drought, seed for the 2020 season was in short supply and often of a lower quality, resulting in a low or irregular plant emergence. A severe virus epidemic occurred in 2020, mainly *Bean yellow mosaic virus* (BYMV), which caused high crop losses throughout northern NSW. The virus appeared to be particularly damaging in paddocks with a poor plant emergence.

The devastating virus epidemic concerned growers about the potential of virus seed transmission in seed harvested from virus-affected paddocks. NSW DPI provided free seed testing for BYMV transmission. Over 50 faba bean seedlots were submitted to NSW DPI Tamworth. Of the PBA Warda$^{\Phi}$ seedlots submitted, 18 lots had enough seed for a replicated yield test to investigate whether virus-infected plants can affect quality and yield potential of the harvested seed.

Site details

Location	Liverpool Plains Field Station, Field 2: 1° 1826′ S, 150° 4256′ E.
Paddock history	2020 fallow
Soil type and nutrition	• Grey/brown vertosol • pHCa 7.6–8.0.
Rainfall	• Total rainfall 1011 mm (Figure 1), of which 336 mm was recorded during the growing season (May–October).
	• No pre-sowing or in-season irrigation was applied.

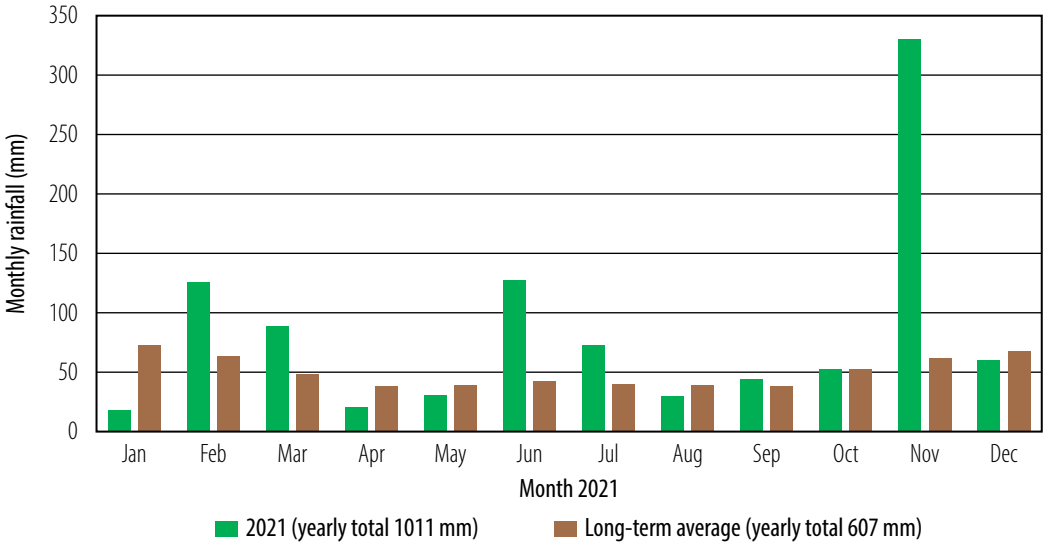

Figure 1 Monthly rainfall for the Liverpool Plains Field Station for 2021 and long-term average.

Experiment design	• Sown on 2 m wide irrigation beds using a randomised complete block design. • three replications • three rows: 7.5 m length with 0.45 m row spacing within plots and 1.10 m between plots.
Sowing date	12 May 2021.
Fertiliser	No fertiliser applied.
Sowing rate and established plant population	All seed lots used were graded by hand and small and discoloured seeds were discarded. Sowing rate of 300 seed/plot was used for a target population of 30 plants/m^2.
Weed management	Terbyne® @ 1 kg/ha (750 g/kg terbuthylazine) + glyphosate (450 g/L) @ 1.5 L/ha applied on 12 May before sowing.
Disease management	Two preventative fungicide applications were made before predicted rain: 1. Aviator® Xpro® @ 0.6 L/ha (150 g/L prothioconazole and 75 g/L bixafen) applied on 8 July. 2. Veritas® @ 1.0 L/ha (200 g/L tebuconazole and 120 g/L azoxystrobin) applied on 28 July.
Insect management	Steward® EC 0.3 L/ha (150 g/L indoxacarb) applied on 4 October 2021 for *Helicoverpa* spp control.
Emergence counts and NDVI readings	
Plant emergence counts	Taken on 23 June by counting emerged plants in the centre row of each plot. On 20 July, images of the trial were taken by a Parrot Sequoia + multispectral sensor mounted on a DJI Phantom 4 drone. normalized difference vegetation index (NDVI) plot readings were extracted from the images using QGIS and PIX4D software.

Harvest date	9 November 2021.

Treatments

Seedlots (23)

- Eighteen farmer grown seedlots
- Two commercial seedlots
- Three seedlots harvested from 2020 LPFS trial plots with contrasting levels of BYMV infection.

For 10 farmer grown seedlots, the BYMV infection levels during the 2020 season were: 4 low, 2 moderate and 4 severe.

Results

Plant emergence and NDVI readings

The seedlot plant emergence varied between an average of 64 plants/row for seed originating from a severely BYMV infected 2020 LPFS plot and 110 plants/row from a farmer's seedlot that had a low BYMV infection level in 2020.

NDVI plot readings ranged from an average of 0.485 for a farmer's seedlot that showed a very high level of BYMV in 2020 to 0.671 from a farmer's seedlot with an unspecified level of BYMV infection in 2020.

Plot readings for plant emergence and NDVI were significantly correlated (Figure 2).

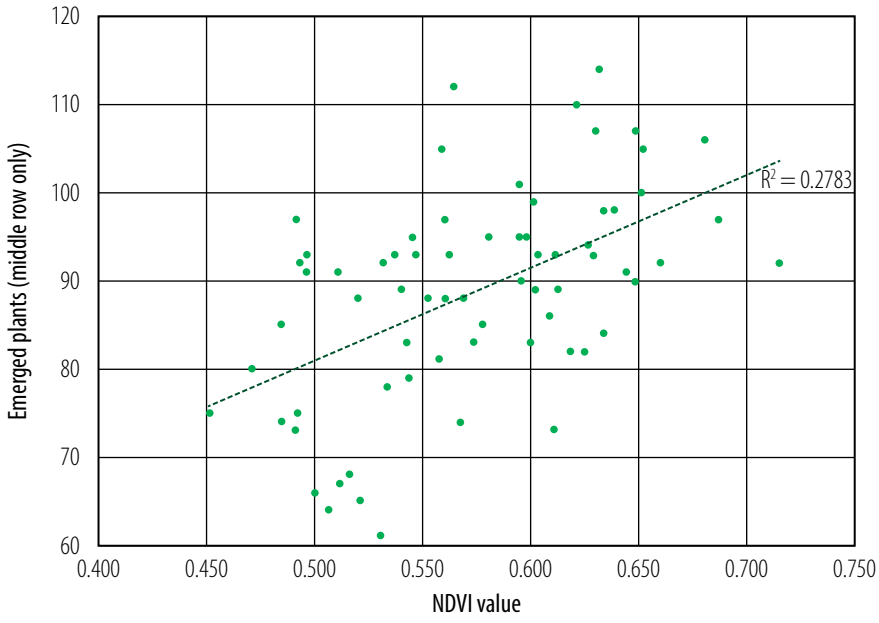

Figure 2 Relation between 69 PBA Warda(b) plot readings for plant emergence and NDVI, Liverpool Plains Field Station 2021.

Grain yield

Grain yields varied from 3.47 t/ha for a farmer's seedlot harvested from a paddock with a severe level of BYMV in 2020 to 4.33 t/ha from a seedlot harvested from a plot in the 2020 LPFS trial with a low level of BYMV.

Average grain yield was positively correlated with the NDVI readings (Figure 3, r =0.452), but not with the emerged plant count (r =0.274). There was no clear relationship with the level of virus infection and yield (Figure 3), but the lowest yielding seedlots originated from paddocks with severe or moderate BYMV levels.

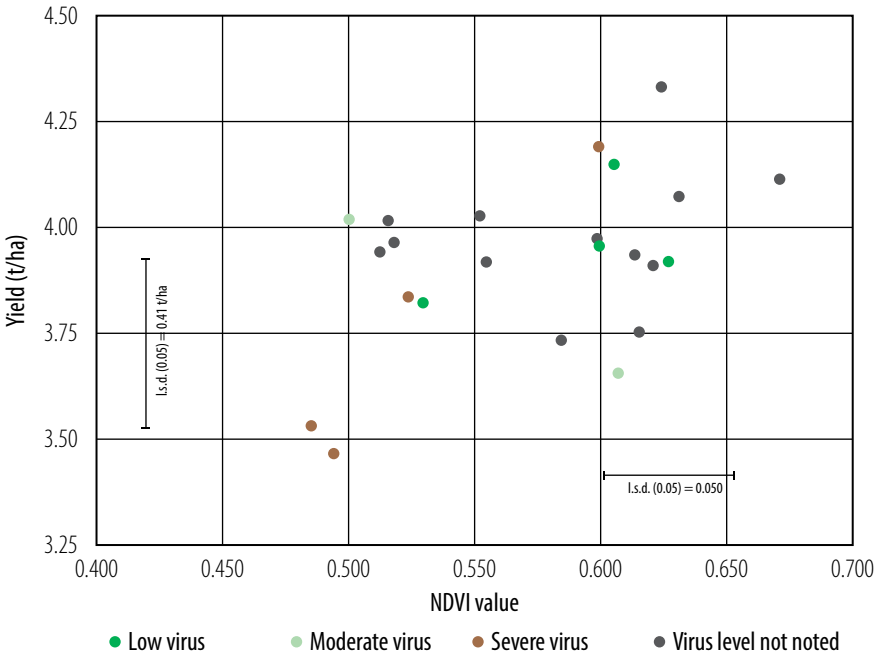

Figure 3 Relation between NDVI and yield (averages over 3 replicates) for 23 PBA Warda[D] seedlots, Liverpool Plains Field Station 2021

Conclusions

The large yield differences in vigour and yield potential among the PBA WardaA seedlots harvested in 2020 confirmed preliminary findings in earlier years of a 20%yield penalty for the poorest seedlot compared with the best performing lot. No clear relationship between the level of virus infection in the crop and the yield potential of the harvested grain was found, but growers' ratings were likely subjective and were only provided for a limited number of seedlots. Using actual yields of the 2020 crops as a variable to relate to the 2021 results might have been more descriptive, but unfortunately, we did not have this information for farmers' submitted seedlots.

NDVI readings related well to early growth vigour and yield. More frequent early NDVI measurement could help to measure differences in seedling vigour among seedlots.

Testing BYMV infection of over 7000 seedlings grown from 54 seedlots harvested in 2020 from BYMV infected paddocks only yielded a single BYMV positive plant. BYMV seed infection of faba bean is therefore not considered to be of epidemiological significance. Nevertheless, growers were advised to avoid using seed from severely infected paddocks as poorly growing crops are likely to yield seed with lower seedling vigour and yield potential.

Acknowledgements

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