Effect of harvesting stage, location and genotype on environmental staining in faba bean (*Vicia faba* L.)

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Abstract

Environmental staining in faba bean is characterised by a dark brown, grey or black, grainy discolouration of the seed coat at harvest. Its cause is unknown, and is not thought to be caused by a pathogen. Observations indicate that environmental conditions e.g. temperature, frost, light and rainfall especially during pod and seed formation affect the severity of environmental staining. To test the hypothesis that seeds formed under stressful conditions will have a higher degree of staining, seeds were harvested from trials located in contrasting environments in Western Australia over two years. Seeds that formed later in the plant's development (located on the upper nodes) had more staining than seeds formed earlier (located on the lower nodes). At some sites seeds formed on small plants had more staining than seeds formed on large plants. Fiord showed a higher amount of staining than Ascot, Fiesta or Cairo when grown in the mild, southern environments. Early harvesting did not reduce seed staining.

Introduction

Seed discolouration is widely recognised as an important factor affecting marketability of Australian faba beans. There are several types of discolouration of faba bean seeds. This study relates to discolouration that occurs prior to harvest which is generally known as environmental staining. It is characterised by a dark brown, grey or black, grainy discolouration of the seed coat. Its cause is unknown, but it is not thought to be caused by a pathogen.

A number of environmental conditions such as temperature, rainfall and light intensity, especially during pod and seed formation, may affect environmental staining. Growers of light red kidney beans often observe that beans darken in the pods when harvest is delayed after pods and seeds are fully mature (Hughes and Sandsted 1975). Environmental factors are known to alter the biosynthesis of flavonoids which are key colouring agents in seeds/plants (Herrmann and Woldecke 1977). This study was aimed at exploration of the influence of environmental factors on seed staining.

Methods

Seeds of four commonly grown varieties of Western Australia (WA) (Fiord, Fiesta, Ascot and Cairo) were harvested from trials located in contrasting environments in Western Australia (Dongara, Mingenew, York, Katanning and Borden) over two years. Ten plants (5 big and 5 small) were harvested manually from each of 4 replications in a block. The main stem of each plant was selected and seeds were separated manually from pods at each node and scored for staining (Not stained = 1, Slightly stained = 2, Moderately stained = 3, Highly stained = 4, Badly stained = 5). Seed bearing nodes on the main stem were divided into 3 groups (top 2, middle 2 and basal; rest of the lower nodes). Seeds at each node were counted and packed separately.

Plants were harvested at two stages. 1) At 90% maturity (about 3-4 weeks earlier than the normal harvesting time depending on weather condition especially temperature) and 2) at full maturity (normal harvesting time for that area).

Statistical analysis

Analysis of variance model was used to compare the varieties x harvest time x node x plant size factors within each trial using the REML procedure in GenStat 2005 (GenStat for Windows, 8th Edition, VSN International Ltd, Roth Amsted, England).

Results and Discussion

Seed formed at the top of plants always had more staining than the seed formed elsewhere on the plant (Figure 1). Generally, though, nodes in the middle of the plant produced seeds of similar staining to those formed on lower nodes. This trend was constant at all locations except York where the seeds formed on central nodes were more stained than those formed on the lower nodes.

At Dongara, Katanning and York there was an effect of plant size on staining of seeds. Seeds from big plants had less staining than those from smaller plants (Figure 1). At Borden and Mingenew, plants could not be collected for the comparison of the effect of plant size on seed staining.

At Katanning and Borden (southern part of wheat belt) there was a varietal influence on the amount of staining. Fiord was more stained and Ascot, Fiesta and Cairo had almost similar staining levels.

The time of harvest did not affect staining level with early harvesting (at 90% maturity) having no effect on staining.

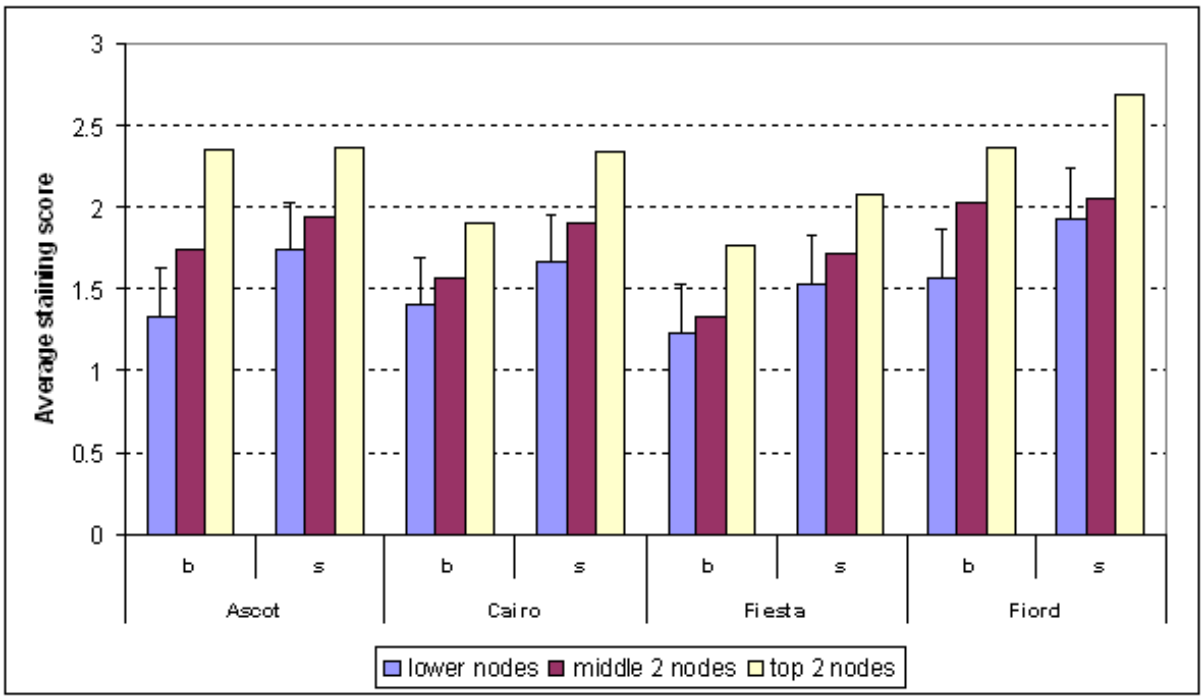

Figure 1. Effect of variety, plant size and seed position on environmental staining in faba bean (Katanning trial; b = bigger plants; s = smaller plants)

Conclusion

Environmental conditions during the growing season affected seed staining in faba bean. Seeds borne on the top of plants had more staining. It might be due to growth under water stressed condition of terminal drought or higher temperature and more sunshine. Seeds from smaller plants, which presumably grown under more water or nutrient stress had more staining. Cultivar was important and Fiord had more staining than Ascot, Fiesta and Cairo. The information will be useful for faba bean growers and scientists/researchers.

References

Herrmann K and Woldecke M (1977). The flavonol content of peas as influenced by variety and light, and a note on the flavonol content of broad beans. Journal of the Science of Food and Agriculture 28: 365-368.

Hughes PA and Sandsted RF (1975). Effect of temperature, relative humidity and light on the color of 'California Light Red Kidney' bean seed during storage. Hortscience 10: 421-423.