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Research Application Summary

Association of seed coat colour with germination of three wild mustard species with agronomic potential

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Abstract

Seed dormancy and germination present significant challenges when wild species are domesticated for cultivation and economic exploitation. Wild plant species are generally characterized by dormant seeds with variable germination widely spread over time. The objective of this study was to evaluate influence of colour selection on seed germination of wild mustard (*Brassicaceae)* species that have been identified as wild edible leafy vegetable in South Africa. Seed lots were separated by colour and germinated after chilling and after-ripening for 6 months. The light seed lot of cultivar *Kwayimba* showed higher germination percentage than the dark seed lot of the same cultivar but colour selection did not improve the germination in cultivars *Isaha* and *Masihlalisane*. The dark seed lot of *Kwayimba* recorded the lowest germination percentage and the slowest germination rate. Chilling improved the speed of germination in wild mustards, but after-ripening had no effect. Seed colour change in wild mustards intensifies after physiological maturity and may be accompanied with weight increase or not. The seed coat colour may not be a good indication of the physiological status of the seed but together with physiological tests (germination) can give insight on the quality of a seed lot.

Key words: Image analysis, seed colour, seed germination, wild mustard

Résumé

La dormance des graines et la germination présentent des défis importants où les espèces sauvages sont domestiquées pour la culture et l'exploitation économique. Les espèces de plantes sauvages sont généralement caractérisées par des graines dormantes avec une germination variable largement étalée dans le temps. L'objectif de cette étude était d'évaluer l'influence de la sélection de couleur sur la germination des graines de l'espèce de moutarde sauvage (*Brassicaceae)* qui a été identifiée comme légume à feuilles sauvage comestible en

Afrique du Sud. Les lots de semences ont été séparés par la couleur et germés après refroidissement et après maturation pendant 6 mois. Le lot de semence clair du cultivar *Kwayimba* a montré un pourcentage plus grand de germination que le lot de semences sombre de la même variété, mais le choix des couleurs n'a pas amélioré la germination des cultivars *Isaha* and *Masihlalisane*. Le lot de semence sombre de *Kwayimba* a enregistré le plus faible pourcentage de germination et le taux de germination le plus lent. Le refroidissement a amélioré la vitesse de germination dans les moutardes sauvages, mais l'après-maturation n'a eu aucun effet. Le changement de couleur des semences dans les moutardes sauvages s'intensifie après la maturité physiologique et peut être accompagnée d'une prise de poids ou non. La couleur des graines peut ne pas être une bonne indication de l'état physiologique de la graine, mais ensemble avec des tests physiologiques (germination) elle peut donner un aperçu sur la qualité d'un lot de semences.

Mots clés: Analyse d'image, couleur des graines, germination des graines, moutarde sauvage

Background

Diversification through domestication of locally adapted wild species of known nutrient quality has been suggested as more appropriate and could improve food security (Jansen van Rensburg *et al*., 2004). However, wild plant species are generally characterized by dormancy and variable germination behaviours that hinder or slow down their cultivation. The seeds show wide morphological variations including colour, and colour selection has been recommended as a quick method of improving seed quality.

Literature Summary

Seed colour has been reported to play a role in seed dormancy and germination, as seeds attain their specific colour at physiological maturity (Powell, 1989; Ochuodho, 2005). Seed coat pigmentation and structure have been shown to influence germination (Debeaujon and Koornneef, 2000; Debeaujon *et al*., 2000). While dark coloured testa accompanied with slow water uptake was attributed to the presence of phenolic compounds and tight adherence of the seed coat to the embryo in legumes, some dark soybean cultivars whose seed coats are loosely attached to the embryo showed greater rate of imbibition and fast germination (Chachalis and Smith, 2000). Atanassova *et al.* (2004) showed that seeds of three anthocyaninless mutants in tomatoes germinated faster than the wild type. The inner epidermal testa layer in these mutants did not have condensed

tannins that contributed to the rigidity of cell structure, thereby reducing permeability. Light coloured seeds of radicchio were shown to have reduced germination and as seed colour became darker, seeds showed higher, faster and more uniform germination (Pimpini *et al*., 2002).

Study Description

Three local vegetables in South Africa known as *Isaha* (I), *Kwayimba* (K) and *Maslahlisane* (M) were used. *Maslahlisane* and *Isaha* were originally collected from KwaZulu-Natal, while *Kwayimba* was obtained from Eastern Cape Province. The seeds were visually selected on the basis of colour difference while shining white light on the seeds placed on a dark background and divided into light and dark components (seed lots). This selection produced 6 seed lots, which were each packaged in separate paper bags. The seed lots were analysed with AnalySIS(R), computer software for soft image analysis that determines the exact quality of colour by the wavelength (hue or colour), the saturation (colour purity) and the intensity (brightness).The seeds were germinated directly or after prechilling at 5 – 10 ^{o}C for 5 days or after storage in dry rooms with controlled temperatures of 5 ^{o}C and 20 ^{o}C for 6 months.

Research Application

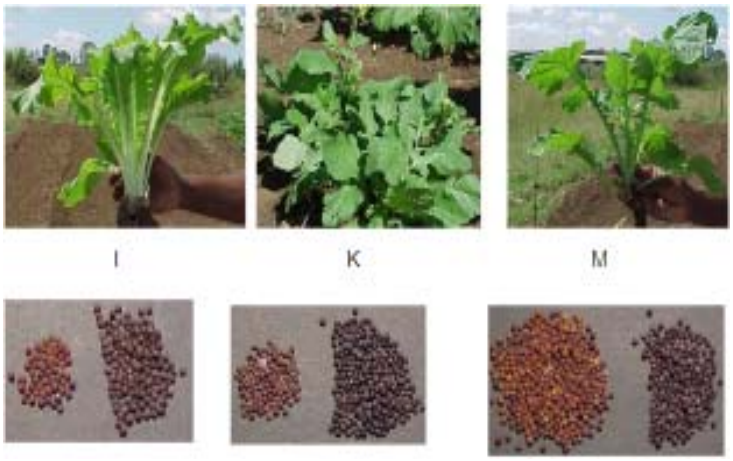

Figure 1. The three local vegetables of South Africa under study at their vegetative stage and their corresponding seeds after visual selection into light and dark seed lots. I – Isaha; K - Kwayimba; M – Maslahlisane. They are of the mustard family.

Colour selection resulted in increased seed germination in cultivar *Kwayimba* (K) but not in cultivars *Isaha* (I) and *Maslahlisane* (M). All the light coloured seed lots showed high germination percentage and one dark seed lot, which was heavier and showed poor germination. The seeds of the wild mustard cultivars turned

black after physiological maturity but only cultivar K may have developed secondary dormancy as it persistently showed low germination. There was no clear relationship between seed colour and seed germination, and therefore colour selection may be an added cost to seed processing without adding value to seed quality.

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References

Atanassova, B., Shtereva, L., Georgieva, Y. and Balatcheva, E. 2004. Study on seed coat morphology and histochemistry in three anthocyaninless mutants in tomato (*Lycopersicon esculentum* Mill.) in relation to their enhanced germination. *Seed Science and Technology* 32:79-90.

Chachalis, D. and Smith, M.L. 2000. Imbibition behaviour of soybean (*Glycine max* (L.) Merrill) accessions with different testa characteristics. *Seed Science and Technology* 28: 321-331.

Debeaujon, I. and Koornneef, M. 2000. Gibberellin requirement for *Arabidopsis* seed germination is determined both by testa characteristics and embryonic abscisic acid. *Plant Physiology* 122:415-424.

Debeaujon, I., Leon-Kloosterziel, K.M. and Koornneef, M. 2000. Influence of testa on seed dormancy, germination, and longevity in *Arabidopsis*. *Plant Physiology* 122:403-413.

Ochuodho, J.O. 2005. Physiological basis for seed germination in *Cleome gynandra* L. PhD Thesis, University of KwaZulu-Natal, Pietermaritzburg, South Africa.

Powell, A.A. 1989. The importance of genetically determined seed coat characteristics to seed quality in grain legumes. *Ann. Bot.* 63:169-175.