A STUDY OF THE RELATIONSHIP BETWEEN SEED QUALITY AND COMMERCIAL SPROUTING QUALITY OF GREEN GRAM (*Vigna mungo* L. Hepper) AND BLACK GRAM (*Vigna radiata* L. Wilczek)

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ABSTRACT

Standard seed quality tests (seed moisture content, thousand seed weight, topographical tetrazolium, germination and seedling evaluation); vigour tests (accelerated ageing, conductivity, rate of germination and uniformity of germination) and industry based tests (oversoaks and sprouters) were evaluated for their ability to rank eight black gram (*Vigna mungo* L. Hepper) seed lots and seven green gram (*Vigna radiata* L. Wilczek) seed lots for the purpose of commercial sprouting. Each seed lot was sprouted using simulated commercial conditions (19°C water temperature; 20°C cabin temperature; dark; 5 days). Seed lots which performed well under these small scale commercial production (SSCP) conditions, in terms of total fresh yield and healthy sprout yield, were considered to be the best quality seed lots.

All tests were able to significantly determine differences among seed lots within each species. Linear regression analysis indicated that interim germination (R^2 = 79.1%), final germination (R^2 = 76.3%), seed moisture content (SMC) (R^2 = 63.7%) and oversoak sprouters (R^2 = 60.6%) were significantly related to total fresh yield in green gram seed lots only. No other significant linear relationships were found for either green gram or black gram. Incorporating interim germination, final germination, SMC and oversoak sprouters in a multivariate analysis reduced the level of unexplained variation in green gram total sprout yield. The best combination was interim germination and oversoak sprouters (R^2 = 84.2%); Y = 9.1(%interim germination) - 8.1(oversoak %sprouters) + 731.4. Very similar to this was the combination of final germination and SMC (R^2 = 83.8%); Y = 4.7(%final germination) + 15.3(%SMC) + 165.4.

The reason for the differing responses of black gram and green gram was not explained, but both genetic variation and differences in environment during seed development and handling prior to testing are likely causes. It was not possible to use any individual or combination of tests to predict sprouting performance for green or black gram with the accuracy the sprouting industry would require. However, the results have shown that it will be possible to eliminate many of the seed quality tests examined from further research. Refinement of test procedures for the relevant standard and industry based tests will be required to provide the accurate seed testing regime needed by the sprouting industry.

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CHAPTER 1

INTRODUCTION

Green gram and black gram (*Vigna radiata* L. Wilczek and *Vigna mungo* L. Hepper respectively) are just two of many legume species which are purposely sprouted, to produce a fresh vegetable for human consumption. These species are believed to be of Indian or Indo-Burmese origin, and have been cultivated in the Indian subcontinent and adjacent regions for several thousand years (Bailey, 1949; Jain & Mehra, 1980; Valvilov, 1926 - cited by Lawn & Imrie, 1991). Generally, green gram is preferred for sprouting in China, Thailand, Europe, the United States of America and Australia, whereas black gram is preferred in Japan and New Zealand.

Regardless of whether sprout production is on a commercial basis or in the home, the sprouter aims to produce sprouts that are tasty, attractive in appearance and bacteriologically safe to eat. Factors affecting appearance include: sprout colour, sprout size, presence of roots, age and contaminants. The last two factors can also affect taste (Imrie, 1991). Many people think that sprout production is a simple germination process. However, anyone producing sprouts commercially (commercial sprouter) will always face at least three problems: 1. long roots and slender hypocotyls; 2. spoiling; and 3. anthocyanin formation in the cotyledons and hook region. Among these three, the most difficult is how to produce short-rooted and large diameter sprouts (Chang, 1978). For most Western markets, the ideal sprout has a 50mm long hypocotyl which is 3mm in diameter, (Ashley Berrysmith, Auckland pers. comm., 1996). A commercial sprouter also requires a high sprout yield (kg sprouts produced per kg

seed used) and sufficiently long shelf life to ensure extended consumer acceptance (Imrie, 1991). Although the procedure of sprouting seeds has been undertaken for centuries, and the general technique is simple, the consistent production of high quality sprouts has proven difficult.

Recently, sprouters in New Zealand, Australia, Europe and the USA have expressed concern regarding the quality of sprouts being produced. The emphasis has been on sprout uniformity within and between batches, with many sprouters finding it difficult to consistently produce uniformly short, stout, white sprouts. Both variability in the initiation of germination and the rate of seedling growth have been suggested as probable causes of poor sprout uniformity, (Robert Coulson, Feilding pers. comm., 1995), with variation between seed lots common. Yield losses from microbial spoilage and human health related problems are also of concern to sprouters. Quality is determined by the end-user, and problems arise when different end-users place emphasis on different quality attributes (Law & Law, 1991). This problem intensifies when aspects of sprout quality cannot be directly related to seed quality parameters, or the relationships between parameters are unknown.

Seed quality is determined by two parameters - genetic as determined by cultivar, and environmental as determined by the conditions under which the seed is produced (Copeland & McDonald, 1985). High seed quality is fundamental in the production of high quality sprouts. Most sprouters are not in a position to dictate seed production management, apart from demanding a particular cultivar. Therefore, accurate assessment of seed lot quality prior to purchase is imperative when selecting seed lots destined for sprout production. There are ten components of seed quality (Thompson, 1979): analytical purity, percentage of

weed seeds, germination capacity, seed size, seed health, species purity, cultivar purity, vigour, seed lot uniformity and seed moisture content. These components are not all of equal value, nor is their order of relative importance the same in all circumstances.

The importance of seed quality has long been known by those in the seed production business. This has lead to the development of several rapid and reliable laboratory test procedures which have been standardised for most important plant species (completed and published by the International Seed Testing Association - ISTA, and the Association of Official Seed Analysts - AOSA) . Internationally accepted tests (ISTA, 1996) can be used to evaluate viability, moisture, seed weight, health and purity of seed lots, while new tests (not yet internationally standardised or agreed upon) have concentrated on assessing seed vigour. All these tests have one thing in common - they were devised in an effort to evaluate the field planting value of seed, not commercial sprout production. Germination, purity and health tests are presently used to evaluate the suitability of seed lots for sprouting, even though the relationships between test parameters and sprout quality are not well understood. Accurate selection of high quality seed for sprouting purposes will not be possible until these relationships are established.

The general objectives of this study were therefore:

1. To determine the quality of a number of available green and black gram seed lots - using the standard ISTA recommended test procedures.

2. To evaluate methods for determining uniformity in green and black gram seedling growth by the use of ISTA recommended seed vigour tests.

3. To determine the health status of submitted seed lots using standard ISTA procedures.

4. To evaluate the sprouting performance of seed lots using a 'small-scale' commercial sprouter, with emphasis on sprout yield and quality.

5. To determine the relationships between seed quality parameters and sprouting variability, correlating results from tests conducted in objectives one to three with small-scale commercial production results.