AN OVERVIEW OF THE AGRONOMIC PRODUCTION CONSTRAINTS TO BLACK-EYED BEAN (BEB) COWPEA TYPE (VIGNA UNGUICULATA (L.) WALP) FOR LEAF AND GRAIN UTILIZATION IN ZIMBABWE

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ABSTRACT

Black-eyed bean has gained popularity in the Mashonaland East Province of Zimbabwe. It is a crop of considerable importance due to its economic value and export potential. A participatory rural appraisal (PRA) was carried out in 2007-2008 rainy season to find out the production constraints to BEB production in the area. The acceptance of this variety was very impressive due to its favourable advantages over the traditional varieties grown in the area. However, yields were very low as compared to the ones the farmers were informed by the non-governmental organization when the crop was introduced to them. Informal discussions were held with farmers in the villages on the issues regarding major BEB constraints. The major constraints were identified and ranked in their order of importance using a pair-wise ranking tool as: soil fertility, pests and diseases, plant populations and spacing, seed shortage and storage, planting methods and planting dates, changing rainfall patterns, intercropping and weeds. Overall, poor management practices of BEB production causes yield reduction. This information is envisaged to be useful in designing and determining the possible way forward for the development of well-tailored objectives to improve the crop for maximum growth in terms of production and exports markets to obtain foreign currency earning.

Keywords: Black-eyed bean, constraints, yield.

INTRODUCTION

Cowpea (Vigna unguiculata L. Walpers) is the second most important pulse grown in Africa (Bussy, 1975) and the most commonly grown pulse in the communal areas of Zimbabwe (Greenberg, 2000). In these communal areas, cowpea is grown for its tender leaves, green pods and dry grain, to meet the protein and other nutrient needs of communal and city dwellers. This protein and nutrient source is relatively cheap as compared to animal protein sources such as meat (Diouf, 2001).

Cowpea is a herbaceous summer annual, which exists in a large variety of forms. These forms vary from upright types, which take three months to mature, to spreading types which take five months to mature (Johnson, 1970). Smallholder farmers prefer the spreading types as these produce high amounts of leaf that are consumed as vegetable. In addition, spreading types tend to be indeterminate, thus they produce tender leaf over prolonged periods. However, these traditional and spreading cowpea varieties grown by local smallholder farmers are generally low yielding, achieving less than 500 kg ha⁻¹ (Mariga et al., 1993). Leaf harvesting, among other factors is known to be a contributing factor to this low grain yield (Madamba, 2000; and Nielsen, Ohler and Mitchell, 1997).

Black-eyed bean (BEB) was introduced in the country as a highly nutritious and relatively low input crop for smallholder farmer, and has an added advantage of having a high market potential. Black-eyed bean is gaining considerable importance in Mashonaland East province on account of its economic value and
especially its export potential as a new crop. Although
black-eyed bean is now an important crop, its yield is
still low about 500kg ha⁻¹ even though potential yields
can be double or more (Madamba, 2000). This is
attributed to several problems including pests and
diseases in the field and in storage, resulting to seed
shortages. In order to reduce the impact of these
problems, a BEB project was initiated at the University
of Zimbabwe in 2005. The objectives of the project
were to (i) establish the status of BEB based cropping
systems in Mashonaland East Province, Mutoko District,
paying particular attention to production constraints
(ii) to determine the effect of leaf harvesting on grain
yield and (iii) assess the response of the local landrace
and BEB to leaf harvesting duration. The major findings
showed that BEB production has to increase in order to
meet household and export marketing requirements.
In addition, poor soil fertility was the most significant
biological constraint to BEB production, followed by
pests and seed shortages. Using pesticides and using
good quality seeds were suggested by farmers as
important in increasing BEB production.

MATERIALS AND METHODS
The participatory rural appraisal was carried out in the
eastern parts of Mutoko Communal Area Katsukunya
villages under Chief Kanyongo 15km from Mutoko
centre and 146 km north-east of Zimbabwe’s capital
Harare, in Mashonaland East Province. Mutoko has a
semi-arid climate with an average annual precipitation
of 650 mm falling between November and mid-March
with frequent dry spells. The area is in Natural Region
IIIb characterised by the tropical savanna with three
marked seasons: a warm wet summer (November-
April), a cool dry winter (May-August) and a short dry
spring (September-October) (Nyamapfene, 1991).
Most soils in the area are sandy with low land-use
potential. The cropping season starts around November
and lasts until the end of April. There are periodic
seasonal droughts and severe dry spells during the rain
season hence drought tolerant crops are recommended.
The area was chosen because it simulates conditions
under which most small-holder farmers are located and
also other cowpea varieties do well under the
conditions in the area. Cropping, gardening, livestock
rearing, fruit production and forestry are integrated on
these communal farms. Mechanisation is very low and
family labour is the main labour source. According to
the ¹Central Statistical Office (1993), the area is densely
populated, with thirty persons per square kilometre.
Participatory rural appraisal (Bhadahri, 2003) is an
approach used by non-governmental organization and
other agencies involved in international development.
The approach aims to incorporate the knowledge and
opinions of rural people in the planning and
management of development projects and
programmes. Informal discussions and dialogues
among farmers’ groups were used to establish major
BEB production constraints. Then the constraints were
ranked in their order of importance using participatory
value judgments by 19 females and 26 males. A pair
wise ranking tool was used to rank the constraints.

Pair-wise ranking: Pair-wise ranking is a tool that
helps to identify the most important needs and
concerns of beneficiaries (Russell, 2001). This
methodology allows comparison of different people’s
priorities to be made in a participatory way. This helps
to develop project ideas that respond to beneficiaries’
priority needs and interests. Therefore this
methodology was used in this study to identify the
major constraints to BEB production in order to
increase the leaf and grain yield.

RESULTS AND DISCUSSIONS
Constraints to BEB production in Mashonaland East
Province, Mutoko,Zimbabwe: The following are some
of the constraints hindering BEB production in the
province. The numbers of production constraints were
reported by farmers (Table 1) which is an implication
that farmers were well knowledgeable with the major
constraints to BEB production. They are mentioned
and ranked in order of perceived importance. These
findings are in agreement with some of the earlier work
reported on cowpea (Greenberg, 2000).

Soil fertility: Farmers attributed low yields of all their
crops to poor soil fertility, which is particularly so in
the rural areas of Zimbabwe. The low yield could be is
caused by imbalanced nutrition. Most rural areas in
Zimbabwe comprise of light, sandy soils which favour
the crop growth, but these are often poor in fertility and then receive low rainfall. Despite this problem, the survey conducted revealed that farmers in Mutoko hardly apply mineral fertilizers to cowpea yet nitrogen and phosphorus are limited in the soils in these areas. Therefore the fertility of these soils where cowpea is grown is generally poor.

Also, farmers put crops of high preferences in fertile land like maize, beans, groundnuts, and bambara nuts. Recent analysis of soil samples from Mutoko District, Nyadire area showed that these soils are well below the optimum requirements of nitrogen, phosphorus and potassium for cowpea production although the crop does produce its own nitrogen (Table 2). The Mutoko soils are also very acidic hindering the uptake of phosphorus by the plants. However, to overcome the poor soil fertility status of the soil, farmers practice some kind of soil enrichment, whereby they add ameliorates like cattle and chicken manure, compost and tree leaves (Figure 1).

Cowpea has a high phosphorus requirement, because P is reported to stimulate root and plant growth, initiate nodule formation, as well as influence the efficiency of the rhizobium–legume symbiosis. It is also involved in reactions with energy transfer, more specifically ATP in nitrogenase activity. As a legume cowpea fixes its own nitrogen, therefore they do not need nitrogen fertilizer; however applying nitrogen at a rate of 25kg per acre may boost early growth, and increase the height of the pod set. Therefore, there is need to use inorganic fertilizers but, the use of commercial phosphorus fertilizers in Mutoko District, is limited due to the high cost of transported fertilizer.

Table 1. Pair-wise ranking of BEB production constraints in Mutoko District.

<table>
<thead>
<tr>
<th>Constraints</th>
<th>Total Score</th>
<th>Rank</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil fertility</td>
<td>26</td>
<td>1</td>
<td>17.8</td>
</tr>
<tr>
<td>Pests and diseases</td>
<td>23</td>
<td>2</td>
<td>15.8</td>
</tr>
<tr>
<td>Plant population and spacing</td>
<td>20</td>
<td>3</td>
<td>13.7</td>
</tr>
<tr>
<td>Seed storage and shortages</td>
<td>19</td>
<td>4</td>
<td>13.0</td>
</tr>
<tr>
<td>Planting methods and planting dates</td>
<td>17</td>
<td>5</td>
<td>11.6</td>
</tr>
<tr>
<td>Changing rainfall patterns</td>
<td>16</td>
<td>6</td>
<td>11.0</td>
</tr>
<tr>
<td>Intercropping</td>
<td>15</td>
<td>7</td>
<td>10.3</td>
</tr>
<tr>
<td>Weeds</td>
<td>10</td>
<td>8</td>
<td>6.9</td>
</tr>
<tr>
<td>Total</td>
<td>146</td>
<td>-</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 2. Summary of soil analysis results for the BEB experimental soils on-station and on-farm.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>UZ Sites</th>
<th>Mutoko Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Block 13</td>
<td>Chinyanga</td>
</tr>
<tr>
<td>Soil texture</td>
<td>MG/SCL</td>
<td>MG/S</td>
</tr>
<tr>
<td>Soil colour</td>
<td>Dark Brown</td>
<td>Light Brown</td>
</tr>
<tr>
<td>pH (CaCl2)</td>
<td>5.5</td>
<td>4.4</td>
</tr>
<tr>
<td>Mineral Nitrogen (ppm)</td>
<td>32</td>
<td>13</td>
</tr>
<tr>
<td>Initial Nitrogen (ppm)</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>Phosphorus (ppm)</td>
<td>38</td>
<td>12</td>
</tr>
<tr>
<td>Potassium (ppm)</td>
<td>0.17</td>
<td>0.14</td>
</tr>
<tr>
<td>Calcium (ppm)</td>
<td>6.72</td>
<td>0.94</td>
</tr>
<tr>
<td>Magnesium (ppm)</td>
<td>2.40</td>
<td>0.36</td>
</tr>
<tr>
<td>Total Chromium (ppm)</td>
<td>9.3</td>
<td>1.4</td>
</tr>
</tbody>
</table>

MG/SCL – medium grained, SCL – sand clay loam, S – sand
**Figure 1.** Some of the fertility ameliorates added to the soil before/at planting.

**Pests and Diseases:** BEB is highly susceptible to insect pests and diseases both in the field and during storage. Insects have been reported as the most serious biological constraints to BEB production in Mutoko. The most serious pest in the field is aphids (*Aphis craccivora*) and they can cause total yield loss and during grain storage in *Callosobruchus rhodesianus* which wipe the whole grain. In an experiment conducted at the University of Zimbabwe Crop Science Department, Entomology laboratory it was found that bean brucids (*Acanthoscelides obtectus*) also attack the BEB grain in the field and storage. *Aphis craccivora* is an important legume pest in Zimbabwe (Madamba, 2000). This species of aphid not only causes direct damage to its hosts but also transmit cowpea aphid-borne mosaic virus. The aphid feeds on the undersurface of young leaves, on young stems and on pods of the crop. This affects the leaves and the farmers are not able to harvest the leaves as they need them for relish. The plants become stunted, leading to leaf distortion, premature defoliation and death of the plant. Although farmers came out with some indigenous cultural methods like spraying cattle urine and ashes on the crop for the control of pests, they could only slow down the pace of the attack on the crop. However, the degree of the success of these different methods was not quantified and also the frequencies of utilization of these methods were difficult to estimate since it depended on the presence of the pests. Also after spraying the farmers are not able to harvest the leaves or the green pods for their consumption as they have to give a period of 7 – 14 days for the pesticides to complete their effectiveness cycle. Snails and cutworm also cause great damage in cooler regions where damage is caused by cutting down of seedlings, this was observed at the University of Zimbabwe experimental plots in 2005 – 6 and 2006 – 2007 rainy season (Dube, 2007). This result lead to both poor and decreased plant stands therefore lowering the BEB leaf and grain yield.

**Plant population and spacing:** Among agronomic practices, plant density plays a vital role in influencing the growth and yield of cowpea. Plant population is a factor that influences yield even in intercropping. Blade, Shett, Terao and Singh (1997) reported that spacing has a great effect on growth and yield of cowpea. Nadeem, Ali, Sohail, and Maqbool reported that legumes sown in 60 cm apart row strip produced significantly higher seed yield than 40 cm apart, of which they concluded that yield of cowpea varied with plant density with low plant populations decreasing yield significantly. Dube (2007) observed that plant population has a significant effect on cowpea leaf area index which increased with increase in plant population. In the same way, number of branches per plant, number of pods per plant and leaf yield increased...
with increase in plant population. Hence, at a high plant density there is low insect pests incidence and damage on the cowpea crop.

Weeds: Weeds are a constraint in that they reduce yield through competition for light, soil nutrients and space. Observations made showed that in the early stages of crop growth, legumes are poor competitors to weeds. However, with reference to BEB severe weed competition can affect grain yield up to about a third of yield reduction and nodule formation for biological nitrogen fixation. On the other hand, BEB has some advantages as it can be intercropped in wide-spaced crops like maize in order to reduce the weed menace. BEB is also efficient in smothering weeds since it is a fast growing legume achieving full ground cover early in the season, which when intercropped suppresses weeds and improves the biological condition of the soil by providing some protection against soil erosion (Singh et al., 1997). There are some cowpea varieties which exude chemical substances from their root system causing suicidal germination of Striga asiatica and Allectra vogelli parasitic weed seeds. These two parasitic weeds infest cereals and have devastating effects on the food security of smallholder farmers in Zimbabwe (Rambakudzibga and Mabasa, 1995). Therefore BEB plays a positive role on weeds when under different cropping systems.

Planting methods and planting dates: Broadcasting sowing method used by farmers resulted in low yields as often farmers fail to attain the optimum plant population required for maximum yield as seeds are not broadcast evenly. This results in some parts of the field being over sown while other parts are sparsely sown and also it becomes practically difficult to achieve a uniform plant population density in the field. However, some farmers reported that they used row planting method as this has a great advantage than broadcasting. Row planting BEB increased plant growth and yield and it was profitable than broadcasting. This method enables more efficient weed control, utilization of light, water resources and soil nutrients. Planting dates have also an effect on the quality of the seed yield (Mbong, Akem, Alabi, Emechebe and Alegbejo, 2010). Some farmers in Mutoko reported that they planted BEB in November on the onset of the first rains but they later on encountered some challenges on the quality of the cowpea because they get mature for harvesting in the middle of the rains therefore drying becomes difficult. Also early sown BEB had higher incidences of diseases Ascocya phaseolorum resulting in lower leaf and grain yield. Grain yield of early sown BEB were lower in quantity and of poor quality than those of late sown BEB, which were higher in quantity and of good quality. Farmers were planting their BEB in mid-January or end of January in order to achieve the high and good quality grain yield

Changing rainfall patterns: Farmers also reported the change in rainfall patterns as one of constraints affecting their cowpea production. The change in rainfall patterns has greatly affected their farming. A rainfall seasonal calendar derived with the farmers revealed that they used to plant their crops with the first rains in first week of November but these days the rain might start in mid-December or first week of January. There was a general consensus by farmers that over the years the rainfall has become unpredictable and unreliable in both the amounts and intensities. This will affect their cropping season as they will be rushing to put the seed of cereals first and the other seeds of the crop of most preferred crop like groundnuts before BEB. Also mid-season drought occurring yearly affect BEB production and that mid-January to February there is bound to be a drought which sometimes results in very low yields and poor quality of the grain. Floods and too much rainfall have also affected the production of BEB in that diseases outbreaks and waterlogging affect the crop yield. This trend is in collaboration with scientific findings reported on Global Climate Change. Consequently, this change in rainfall patterns has direct influences on land preparation, planting and other practices like weeding, leaf harvesting and pesticide application.

Intercropping: Farmers reported that they intercrop their BEB with sorghum, cotton and maize. Intercropping is a traditional practice that is well entrenched among tropical farmers (Willey, 1979). Intercropping is defined as the practice of growing two or more crops simultaneously in the same field a year or growing season (Mariga, 1993). It is practiced in Mutoko and all other parts of the country by smallholder farmers as a way of maximizing use of the scarce resources such as land. Intercropping is associated with certain advantages like: (i) when in a BEB/cotton intercrop it spreads the spraying labour and chemical use therefore lessen the expenses of insecticides when spraying cotton and cowpea
simultaneously. (ii) Improves soil erosion control (iii) at least there is an insurance if one crop fails there is a possibility of another yield (iv) helps in control of spread of diseases and pests (v) transfer of nitrogen fixed by the BEB to the other crop (vi) helps to improve yields. Both leaf and grain yields maybe low because recommended plant densities and planting practices are not followed, interspecific competition is high, and population density of the BEB is undermined.  

Seed storage and shortages: Although BEB have features desired by consumers as well as farmers it has got some storage challenges as it is easily attacked by storage brucids *Callosobruchus* species. Cowpea is used both as seed and grain. Farmers may be tempted to use them for grain as the market price for grain sometimes exceeds the seed cost. BEB seed must be stored in dry containers such as drums and sacks and store on wooden racks. Farmers in Mutoko District use both cultural and insecticides methods to protect their seed and reduce seed shortages and prolong grain storage life for their own consumption. Poor storage facilities cause seed shortages and it get attacked by brucids and fungi rendering the seed not to germinate. To avoid seed shortages, seeds used for sowing must be from an authentic source which is a source with genetic purity and other aspects of physiological and physical quality. Seed must be vigorous, checked for hardness, disease-free, mature, not shrunken and un-deformed to ensure a good field crop stand. Seed shortage is one of the main reason farmers may not be able to plant as much crop as they wish resulting low leaf and grain yield. The reasons for the shortage may be (i) poverty and low productivity resulting in households having inadequate production and then they are unable to save seed or generate income to buy seed (ii) local seed houses in Zimbabwe and the grain marketing board from which farmers often get seeds, do not have the BEB seed. Seed in the district was through farmer – to – farmer diffusion as the non-governmental organization was not able to distribute to all the villages. Non-availability of good seed for planting discourages farmers and worsens the limitation to BEB production in the area.  

Overall farmers in Mutoko agreed that sometimes the low cowpea yield is partly attributed to improper agronomic practices such as poor planting systems, dependence on recycled lower yielding BEB seed, inappropriate application of organic fertilizer levels in the field and poor pesticides applications and usage. It has been shown that increased grain yield can be enhanced significantly by improving these management practices. Farmers have attributed this to the lack of expertise or misuse of information disseminated to them by the agricultural extension officers in their areas on BEB production. The productivity of cowpea is very low in Zimbabwe compared to the West Africa where Nigeria and Niger are the predominating producers of cowpea (Singh, Mohan, Dashiell and Jackai, 1997). Hence, these constraints to BEB production need to be addressed in order to increase leaf and grain yields.

CONCLUSION  
The future of BEB production in Zimbabwe is very promising due to its features desired by the farmers and consumers coupled with desirable cooking qualities and processing characteristics for the specific products, economic value, and export potential. However, the potential of BEB production in Mutoko is limited by numerous factors, but the major constraints being soil fertility and field and storage pests, which farmers reported could wipe out the whole yield if not immediately controlled. The problem of pests was observed to be the biggest cause of yield loss in cowpea production. The number of insecticide sprayings was also of great concern as this coincided with other farm operations, which were considered more important, like weeding of maize, groundnuts and sorghum, thereby affecting leaf harvesting and spraying of cowpea. The high price of knapsack sprayers and chemicals was also of concern to the farmers as they could not afford, forcing some farmers to drop the production of the crop. Low soil fertility, shading by cereals, and low cowpea population were also identified as constraints. Some Mutoko farmers who owned livestock improved their soil fertility status by applying cow dung, compost or compound fertilizers to enrich the soils. Nitrogen fertiliser has been found to be important only during early seedling stages because plants developed nodules for nitrogen fixation where effective rhizobium strains were available. Low agricultural productivity is central to rural and urban poverty in Africa which also applies to cowpea in general and BEB in particular. Cowpea varieties that yield more without purchasing expensive inputs especially benefit the poor smallholder farmers, many
of them who are women who lack access to the most productive lands. However, BEB productivity is central to increasing rural incomes irrespective of changes in cowpea acreage, because less land, labour and capital are needed to produce the same amount of cowpeas.

**RECOMMENDATIONS**

Sustainable increases in BEB productivity can be achieved by developing cultivars with resistance to insects and diseases, drought tolerance and ability to strive under very low soil fertility. Research, including the use of biotechnology to improve field insect control and postharvest storage of black eyed bean must be done in order to increase its production. Also use of cheap and readily available botanicals to control pests and diseases must be researched upon as farmers cannot afford the expensive chemicals.

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