VOLUNTEER REPORT

Joel Ransom, 1 September, 2017

Kampala, Uganda

1.1 Assignment information

a) Volunteer Name: **Joel Ransom**
b) State of Origin: North Dakota
c) Host Organization: Little Sisters of Mary Immaculate
d) Assignment: Maize Agronomy
e) Dates of Assignment: August 18 to Sept 2, 2017
f) Number of days worked: 14

1.2.1 Objective 1: Improved crop agronomy and management with emphasis and practical hands-on use of improved seeds, better practices such as planting, spacing, weeding, fertilization and weed control.

a) Progress with the objective: Five days of training was given which was a combination of hands on and lectures. Topics included all of the major management practices that go into a high yielding maize crop.
b) Expected impacts/results: The Sisters that were trained with farming responsibility have indicated a desire to incorporate best practices as discussed in the training. I have prepared a production guide (referred to as the Guide) that summarizes these best practices (see annex). Sisters from each region took home samples of each of the improved varieties of maize that we planted as part of our practical experience, so that they can gain experience with them.
c) Recommendations: the specific recommendations given to the sisters on how to improve production are included in the production guide which is annexed. [1]

1.2.2 Objective 2: Improved ways of keeping soils fertile and soil moisture to maintain longer crop production.

a. Expected impacts/results: One of the lectures dealt with soil fertility and one of the practical experiences included the use of the two main fertilizers available to farmers in Uganda, DAP (Di-Ammonium Phosphate) and urea. In the practical experience, we planted an improved hybrid without fertilizer, with DAP, with urea and with the combination of DAP and urea. This should allow the participants to visually see how important each nutrient is in the farm. We also had a practical experience in making compost. It became obvious during this exercise that composting will not be a practical means of improving soil fertilizing in field situations, but for more intense garden application. However, it also served to impress upon the sisters the importance of retaining residues in the farm (not burning them or carrying them off the field prior to land preparation). These residues play an important role in building organic matter and in returning plant essential nutrients to the soil (as they decompose).
b. Recommendations: Sisters are to consider the use of fertilizers as a means of intensifying their production. They should check to make sure that legumes they plant produce nitrogen fixing nodules and that maize follows a leguminous crop when possible.

1.2.3 Objective 3: Ways to control and manage crop pests and diseases on the farm.

a) Progress with the objective: In the lectures we discussed the major diseases and insects of maize. Of particular importance we discussed the life cycle of the recently introduced insect called the Fall Army Worm (FAW). We discussed the concept of integrated control of insects and diseases

and the importance of selecting hybrids/varieties that have genetic resistance to the major diseases. Streak virus resistance, for example should be control by the use of resistant varieties, which are readily available (in fact most if not all of the newly released hybrids/OPV have some level of resistance). Since there are few integrated options for the control of the Fall Army Worm, we discussed its chemical control. Furthermore we had practical experience in calibrating a backpack sprayer and determining the right amount of chemical to add, the right nozzles to use and the timing of chemicals for best control. I was not able to get a list of effective chemicals that can be used in FAW control but there is a recommendation CRS follow up with the Crop Protection Division of the Ministry of Agriculture and provide this list (if it exists).

b) Expected impacts/results: Improved chemical control of FAW should be achieved as the sisters apply the principles outlined in the annexed Guide.

c) Recommendations: In addition to the guidelines in the Guide, in our concluding discussion it was recommended that someone from CRS follow up with the Ministry of Agriculture, Crop Protection Division, to determine if a list of approved and effective insecticides for FAW control is available, and to provide this list to the sisters so that they know which chemicals to use as part of their control program.

1.3 Recommended future volunteer assistance

a. The Little Sister congregation could benefit from having a plan on how to use their rather expansive land holdings to greater benefit. Only a small portion of the total farm is currently being used for production agriculture. Although most of the decision on how to use this resource is dictated by the needs and capabilities of the congregation, someone my help them reconsider options that might allow them to better exploit this resource.

b. Since weed control and land preparations are serious constraints to improve production, there are many questions about how to best integrate herbicides to address this constraint. There is a need for some additional practical research to help generate answers to these questions. There is a potential to use some of my graduate students to help design and implement this research while providing additional training to the group. To ensure adequate follow up on this research, perhaps my students could be linked to a student from Makerere University. There is a chance that I could partially fund this activity.

c. There is a significant lack of published information on best maize production practices by the research and extension system in Uganda. Perhaps a volunteer could explore way to help the research extension system do a better job in availing research findings and relevant production recommendation to growers, NGOs and other stakeholders. This could mean greater visibility on the web, publications available at local extension office, publications and other information available at ag input supply shops.

1.4 Action Plan

Recommendation	Specific Action	Responsible person	By when
1. Little sisters consider intensification of maize production. More production on less acreage	Fields prepared early for planting. If not herbicide, reserve resources to hire tractor. Herbicide especially for perennial grasses. Integrate into part of planting calendar	Clemencia (Farm Manager) draw up plan and list resources Sofia (Projects Coordinator) procurement of resources	Mid-January to mid-February
2. Consider using improved maize hybrids to increase yield	Test materials to determine which are the best. Design method of testing materials. Don't plant entire field, side by side comparison between varieties and local.	Clemencia to draw up plan and implement, Stella procurement of seeds, Clemencia and Stella to review current tests. Joel to find out what varieties have been tested and where sisters can access information	Review tests until harvest mid-January
3. Consider for using fertilizers	Try different regimens. Design tests and record results. Side by side comparison	Clemencia to draw up plan and implement Stella procurement of seeds Clemencia and Stella to review current tests. Joel to find out what varieties have been tested and where sisters can access information	Review tests until harvest, Mid-january
4. Strict program for control of army worm	Follow recommended guidelines (developed by Joel).	Joel to develop guidelines. Clemencia to implement Stella to procure CRS to contact Crop Protection Department MAAIF for list of approved pesticides for FAW	Joel guidelines in September. Mid-January plan and implement

1.5 Number of people Assisted

a) Through formal training (Classroom setup)
b) Through direct hands on practical assistance (Do not double count): 9
c) Out of these above, number of host staffs
d) Training/assistance by field

Category	Total	Males	Females
Members/ owners	9		9
Employees			
Clients/ Suppliers			
Family Members			
Total	9		9

1.6 Gender

a) What gender roles did you recognize in your host community? Did these roles play a part in your assignment? How? This was a rather special assignment in that all of the recipients/trainees were women in an all women organization. There was little discussion about gender as a result of this situation.

b) How might CRS or the host organization improve opportunities for the women in this host or host community? No recommendations.

1.6 Value of volunteer contribution in **$ 7,520**

d. Hours volunteer spent preparing for assignment: 112 hours including the time spent in Uganda.
e. Estimated value of all material contributions volunteer contributed to host during assignment: No materials of commercial value were given. A production guide was prepared that will have direct use by the recipients, however.

1.7 Value of hosts' contribution in **$ 456.54**

a) Meals- $ 110.17
b) Transportation for the sisters and a cost share on volunteer transport: $ 235.09
c) Lodging for the sisters – $ 55.64
d) Translation- N/A
e) Other (Specify)- Training venue- $ 41.73, Mobilization for the sisters (in form of airtime)- $ 13.91
1USD = Ushs 3,594.42

1.8 Host Profile Data:

Did you obtain any data that supplements or corrects the data in the existing host information as detailed in the SOW? No.

1.9 Recommendations for CRS:

a. A more detailed itinerary of my program of work upon or before arrival would have been useful.
b. Might also consider inviting the surrounding community to participate in future trainings. This would have expanded the potential benefit of this training beyond the congregation and potentially

increased the number of participants in the training. I think having interaction with others would have enriched the discussions during the training.

1.10 Press Release

FOR IMMEDIATE RELEASE

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Fargo, North Dakota, NDSU Extension Agronomist Works with Farm Managers in Uganda

Farmer-to-Farmer program promotes economic growth and agricultural development in East Africa

[DATELINE: Fargo, North Dakota, September 6, 2017]--- Joel Ransom, NDSU Extension Agronomist for corn and small grains from Fargo, ND travelled to Uganda for two weeks to share his technical skills and expertise with local farmers. Ransom's assignment is part of Catholic Relief Services' Farmer-to-Farmer program that promotes economic growth, enhanced nutrition through access to healthy food, and agricultural development in East Africa.

"*Even though Uganda is blessed with fertile soils and a nearly perfect climate for corn production, corn yields are low, said Ransom. The training I provide has the potential to increase yield and food security in a region of Uganda where corn is the major food crop."*

Farmer-to-Farmer matches the technical expertise of U.S. famers and professionals in agri-businesses, farming cooperatives, and universities with farmers in developing countries to assist them in improving agricultural productivity, accessing new markets, and increasing their incomes. Farmer-to-Farmer is funded by the U.S Agency for International Development (USAID).

In a world where 80% of food is produced by farmers working on small farms or fisheries, the movement to share proven farming and business skills can improve the quality and quantity of the world's food supply. For communities in the developing world who often struggle to produce enough food, this can improve access to a reliable source of food and better nutrition. For the farmers, it can strengthen their path to prosperity.

The goal of Ransom's assignment was to improve corn production**.** He worked with members of the Little Sister of Mary Immaculate congregation who have farms to support students in their system as well as disabled and retired members. Most of Ransom's time was spent in northern Uganda, near one of the congregation's farm and secondary schools, where he provided lectures and lead practical field experiences.

This is Ransom's fifth volunteer assignment with Farmer-to-Farmer and is one of nearly 500 assignments that focus on improving approaches to local agriculture practices, expanding production of quality food crops and nutrition in Ethiopia, Tanzania, Kenya and Uganda. The program, funded by the U.S. government has been running for nearly 30 years.

CRS is partnering with five U.S. institutions to tap into the rich diversity of the U.S. agriculture community: the National Catholic Rural Life Conference, Foods Resource Bank, National

Association of Agricultural Educators, American Agri-Women, and the University of Illinois' College of Agricultural, Consumer and Environmental Sciences.

The volunteers travel to East Africa for anywhere from one to six weeks.

"We are certain that this program will be beneficial not just to the farmers in East Africa but also to the volunteers from America," said Bruce White, CRS' director for the program. "It's going to make the world a little bit smaller and a whole lot better for everyone involved."

For more information, visit farmertofarmer.crs.org

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Catholic Relief Services *is the official international humanitarian agency of the Catholic community in the United States. The agency alleviates suffering and provides assistance to people in need in more than 100 countries, without regard to race, religion or nationality.* CRS' relief and development work is accomplished through *programs of emergency response, HIV, health, agriculture, education, microfinance and peacebuilding. For more information, visit* www.crs.org *or* www.crsespanol.org *and follow Catholic Relief Services on social media:* Facebook*, Twitter at @*CatholicRelief*, @*CRSnews and @CRSnoticias*,* Instagram*,* Pinterest *and* YouTube*.*

Maize Production Guidelines for Karungu Farm
Little Sisters of Mary Immaculate, Uganda

August, 2017

Prepared by Joel Ransom
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Farmer to Farmer Volunteer
Fargo, ND, USA

Maize is one of the most important crops in northern Uganda and is used for both food and a source of cash. Maize is well adapted to northern Uganda, where temperatures are nearly ideal for its growth and where rainfall is usually adequate to allow for its production during two seasons each year. The Karungu farm consists of about 100 acres, of which about six acres are used for maize production each season. The maize produced on this farm is primarily used within the Little Sisters of Mary Immaculate system. Increasing maize production is a high priority as current levels of production do not meet the needs of the system. Additional maize production might also serve as a source of cash for maintaining the farm and upgrading its equipment.

Where to Plant

Most of the farm has soils that would support high levels of maize production. Maize does not do well in soils that tend to be waterlogged or that are sandy; there are better crops for these types of soils. Maize can be grown continuously, meaning maize can be planted after a previous maize crop. Never the less maize does better when grown after a broadleaf crop, especially a legume like beans. Furthermore, rotating maize with a non-cereal crop generally reduces the potential for the buildup of pest and diseases. Best results will also be obtained when maize is grown in land that is relatively free of established perennial weeds. Maize does not tolerate early competition from weeds, so planting where weeds will be less problematic early in the season or where weeds will be controlled soon after maize emergence will add to its potential for high yield. Productive bean fields that had effective nodules indicating nitrogen fixation is occurring are ideal. Consider using rhizobia inoculum if nodules are not found or are not plentiful on beans that are grown in rotation with maize.

- Key recommendations: Plant maize following a leguminous crop like beans and in fields where early season weed pressure will be low.

When to plant

The general recommendation is to plant as early as possible at the being of the rainy season. Knowing when the rains will begin is not easy due to unpredictable weather patterns and a changing climate. Nevertheless, by planting near the beginning of the season there is a greater chance of having adequate moisture for the crop during key development stages like silking and early grain filling. Furthermore, research has shown that there is often a flush of available nitrogen in the soil that has accumulated during the dry season that potentially could move out of the root zone early in the season if there is no plant to use it. This general recommendation means that most land that will be planted to maize should be plowed and ready for sowing prior to the beginning of the rains if at all possible. Make plans to have the land prepare early so that planting can occur early.

Given the variability in the rainfall timing and the possible lack of uniformity of rainfall during the season, having some later planting dates may reduce the risk of complete losses. When planting later in the season do not use late maturing hybrids/varieties of maize.

What to plant

Using good quality seed of hybrids with improved yield potential and resistance to major pest and diseases can have a dramatic impact on yield. There are a number of hybrids and open pollinated varieties (OPVs) currently available on the market. There is also the option of saving your own seed. When selecting a variety/hybrid, it is recommended that you use reliable research data from experiments performed in a region of the country that is representative of your farm. If data from research is not available, testing small amounts of the various varieties is highly recommended so that you know of their strengths and weaknesses and how they might fit in your farming system. The following is a partial list of hybrids/OPVs and some of their characteristic. NARO may have annual reports that can also be used to help learn the characteristics of released varieties.

Table 1. Available OPVs and hybrids adapted to northern and central Uganda and some of their characteristics and cost.

OPV/Hybrid	Maturity	OPV or Hybrid	Cost per kg
DKC90-89	3 months	Hybrid	10,000
KH 500-43A	3 months	Hybrid	10,000
Longe 5	4 months	OPV	3,000
Longe 10	4 months	Hybrid	6,000
MM3	2.5 months	OPV	4,000
PAN15	3 months	Hybrid	11,000
UH 5051	4 months	Hybrid	
UH 5051	4 months	Hybrid	
UH 5051	4 months	Hybrid	
WE 2114	4 months	Hybrid	
WE 2115	4 months	Hybrid	
WE 3106	4 months	Hybrid	
WE 3109	4 months	Hybrid	

OPVs can be recycled, meaning that you can save seed and still maintain the characteristic of the variety. If saving seed consider the following:

- Select cobs from disease free plants that represent the general characteristics of the variety. Don't select late or early plants or plants that are unusually tall or short, as examples.
- Select from plants that are several meters from the border of the field. Pollen from surrounding fields can contaminate the purity of your variety. This will be more pronounced on the edges of fields.
- Purchasing new certified seed after 3 or 4 season can help ensure the purity of the variety.
- Cobs should be dried to about 13% moisture. After shelling, seeds should be kept dry and treated in a way that they are not damaged by storage insects (weevil, greater grain borer, etc.).
- If you plan to use old seed, do a simple germination test to make sure the seed lot you are using has good germination and vigor. Germination tests can be performed by counting out 50 to 100 seeds, placing them on two to four sheets of newspaper, adding water, covering these sheet and seeds with two to four sheets of newspaper, adding additional water, then rolling up the sheets, and placing them in a plastic bag that is more or less air tight for at least five days. Remove and unroll the papers and count the number of seeds that have germinated. Seed lots with more than 80% germination are preferred. Seed lots with poor germination should be avoided or an adjustment in the number of seed sown should be made if they must be used.

- Seed from hybrid varieties should not be saved. The main issue with saving seed from hybrids is that the productivity of the crop will be reduced by 20% or more.

When purchasing certified seeds the bag should have a blue tag or other form of certification to certify that they are the variety or hybrid specified. Purchase seeds from a reputable dealer. When testing a new variety, plant it near your current variety. Small plots that are repeated usually are the best way to test new varieties. Differences between varieties that are planted in different fields or in large strips that are not replicated could be due to differences in the soil rather than in the performance of the hybrid.

How many seeds should be planted?
In order to intensify production, and obtain greater yield per acre of land, the recommendation is to increase the number of plants per acre and limit the number of seeds sown in each planting hill to two. If growing a hybrid maize and adding some form of fertility, the following is recommended:
Plant in rows that are approximately 75 cm apart (~30 inches) with planting holes every 60 cm (2 ft). The use of strings and marks to ensure exact measures is not needed, but those planting the maize should be trained on how to plant maize with a spacing similar to that just described.

How deep to plant?
Seeds should be planted at least 3 to 5 cm deep. If the soil is dry on the surface, maize can be planted as deep as 8 to 10 cm without the loss of stand. If planting into dry soil in anticipation of rains, plant at least 5 cm deep to ensure that seeds do not germinate after a small shower and then dry out. Avoid mixing fertilizer with the seed as the salt effect from the fertilizer can burn seeds when germinating. If planting two seeds per hill, try to plant both at the same depth so that they emerge at the same time. Plants of equal size do much better than when one plant is significantly larger than the other. Planting deeper than recommended will not ensure that the plants will be more resistant to lodging (falling over when the wind blows). This is because the maize plant establish its crown, from which the secondary root system emerges, at about 1.5 cm below the soil's surface regardless of how deep the seed was planted.

Soil Fertility
There are many plant essential nutrients that are supplied by the soil. Generally, only those nutrients that are used in large quantities by the maize plant, called macro nutrients, limit maize production. Of these, nitrogen (N) and phosphorous (P) are considered the most important in Uganda. In the past, soils provided enough nutrients so that maize yields were acceptable. However, as the amount of nutrients removed by the grain with each harvest has increased, the amount of naturally available soil fertility has declined. Furthermore, as you try to improve yields through a more intensive approach, plant nutrients supplied from external sources are needed. Compost and animal manure can be good sources of N and P, but because the percentage of N and P they contain is quite low, large quantities are needed. Fertilizers are the most common way farmers add these nutrients in intensive agriculture. The following are recommendations for applying these nutrients:

<u>Nitrogen:</u>
- Nitrogen is needed by the plant for all processes that involve protein and in chlorophyll (the part of the plant that give it green color). Nitrogen deficiencies usually show up as yellow or pale green plants that are stunted and grow slowly. Since N is mobile in the plant, the lower leaves will be the most yellow in a severe deficiency situation.

- The most common source of nitrogen fertilizer in Uganda is urea. Urea contains 46% nitrogen and the bag it comes in will be labelled as 46-0-0. This label describes the amount of nitrogen (46%) – phosphorous (0%) and – potassium (0%) in the fertilizer.
- Nitrogen can move and transform in the soil and be lost for crop use, so it is best to apply most of the nitrogen close to when the plant needs it the most. Therefore, if only applying nitrogen, apply about one third at planting and the remaining amount when the maize plant is knee high or slightly larger.
- For most soils a rate of 50 lbs per acre of total nitrogen should be optimum. Since urea is 46% N, this means that in order to apply 50 lbs of N, you need to apply 96 lb of urea (50 divided by 0.46).
- Apply urea when you expect rain in the next few hours or days. A rain of about 1 cm is needed to dissolve the urea applied on the surface and bring it into the root zone. If no rain is expected for some time, urea should be lightly incorporated so that it will not be lost to the air.
- Don't apply urea with the seed because of its salt effect and because it produces ammonia when it dissolves which can also be toxic to seeds and young seedlings.
- Beans are legumes that can fix their own nitrogen. Because specific bacteria are needed to enable bean to fix N, when growing beans in a field that has not be previously been planted to beans, apply a rhizobium inoculum specific for beans. You may be able to obtain innoculcum from Makerere University as it seems likely that there is no commercially available sources in Uganda.

<u>Phosphorous:</u>

- Phosphorous is used in reactions involving energy. Plants that are deficient in P can have purple edges on its leaf. Plants can also be stunted.
- The most common source of fertilizer P is DAP with has an analysis of 18-46-0. This means in addition to having 46% P it contains 18% nitrogen.
- DAP should be applied into the soil and not broadcast on the soil's surface. P does not move in the soil so for the roots of the maize plant to access this nutrient it must be buried in the soil. DAP is often applied in the planting hole. The best practices is to dig a planting hole 10 cm deep, apply the DAP, add some soil then add the seed before covering.
- The best rate for DAP is about 20 lbs per acre of P or about 50 lbs per acre DAP. This rate can be achieved by applying a soda bottle cap (class bottle cap not the newer plastic bottle caps) full in each planting hole.

Weed Control

Weeds compete with maize for water, nutrients, space and light. Weeds are one of the most limiting factors in maize production in Uganda due to high populations of perennial grasses, which are not only competitive with maize but very difficult to control. Effective weed management begins with knowing the weeds you are trying to control. Weeds are classified in various ways that can be helpful as we develop strategies for their control.

Grasses verses broadleaves. Grasses have narrow leaves relative to their length (like maize) and include weeds like star grass, Guinea grass, spear grass. Broadleaf weeds have rounded leaves like those of beans. Some selective herbicides are able to effectively control broadleaf weeds in maize. An example is 2,4-D.

Annual verses perennial. Perennial weeds do not die after seed production like annual weeds. They continue to grow and reproduce by rhizomes, stolons, bulbs, corms, etc. Perennial weeds that reproduce by roots and stolons are very difficult to control by hand weeding as they often proliferate when cut (each new segment can establish as a new plant). Bunch grasses do not creep, but readily re-establish when plowed. They also form such a tight mound around the base of the plants that they create a large bunch that is difficult to manage and plant around. Annual weeds often emerge in very high numbers (relative to perennial weeds) but tend to be much easier to uproot when hand weeding.

Mechanical weed control

Plowing and hand weeding with a hoe are the most common methods of weed control in Uganda. Disc plowing can be an effective method of eliminating weeds that have emerged, but does little to kill the rhizomes and stolons of established perennial weeds. Plowing by hand and early hand weeding is often an overwhelming task if the field has not been previously intensively managed. Chopping of rhizomes and stolons may increase the number of perennial weeds. Generally at least two hand weedings are needed during the growth of a maize crop (in addition to any mechanical weeding prior to planting) in order to control weeds and reduce the production of weed seeds. The first hand weeding should occur early as maize does not compete well with weeds when it is small. Weed control in a well-managed crop (right spacing and fertility) will generally be easier than in a poorly managed one as the crop can shade developing weeds.

Chemical control

There are a number of herbicides that are available for weed control in Uganda. Herbicides can have a residual effect, control on contact and/or translocate. The most important herbicide for use in maize in Uganda is glyphosate. Glyphosate is a non-selective herbicide (kills all plants that it is applied to) that is translocated (meaning that it will move from where it is applied on the leaves to other parts of the plant). Glyphosate can be very effective in controlling both the shoots and roots of perennial weeds. Since it is non-selective, however, it must be applied before maize is planted so that it does not kill the maize crop too. Here are the recommendations regarding the use of glyphosate:

- Best fit is for fields that have high levels of perennial grasses. Apply a week or more prior to planting. A single application can go a long way to eliminating perennial grasses that would otherwise persist and overwhelm efforts for control by hand but it may require a higher rate of application.
- Weeds should be actively growing. If the grasses have been slashed, wait until new regrowth is visible. Good coverage of the leaves by the chemical is important. Avoid drifting of the chemical to any trees and plants that are not to be control. Don't spray when windy.
- Apply when there will be no rain for at least an hour.
- Use the higher rate recommended on the label when applying to perennial grasses.
- If you observe that there is no foam when mixing the chemical with water, add Omo or another detergent to improve its effectiveness. Roundup brand glyphosate has its own surfactant so adding additional detergent is not needed.
- Glyphosate is more effective when applied with water that is low in salts. Rainwater, for example, would be an excellent source of water when using glyphosate.

Integrated control

Integrated weed control is a term used to describe the process of combining approaches to maximize the control of weeds. Combining a glyphosate application for the control of difficult to control perennial grasses, followed by early hand weeding of annuals and closer planting of maize to provide greater

shade and finally controlling weeds later in the season so that no additional weed seeds are produced is an example of an integrated approach for weed control. Rotating maize with beans that might be able to shade out some species of weeds that grow well in maize is another example of integrating control strategies.

Sprayer calibration

It is important to know how much spray you are applying with your sprayer prior to any application. For herbicides, use the flat fan nozzle, not the cone nozzle. The steps of calibration are:

1. Determine the speed it takes to walk through the field, 100 feet length, using the same pace the person will use when spraying.
2. Measure the width of the spray pattern by spraying a dry slab or cleared area of soil where you can actually see the pattern. We determined the width of the nozzle supplied with the sprayer we calibrated (using a nozzle height of about 18 inches about the soil) to be about 5 ft.
3. Determine how many seconds it takes to fill a 500 ml water bottle.
4. Solve for the following formula to determine the number of liters you are applying to an acre.

   Liters per acre = ((# seconds to walk 100 ft as in #1 above /100ft x width of spray as in #2)) x (43,560 ft^2 in an acre) x (0.5 liters/time to fill bottle as in #3 above)

   Example:
   1-20 second to walk 100 ft
   2- Width was 5 ft
   3- 20 seconds to fill half liter bottle

   43 liters per acre = ((20sec/(100ft x 5 ft)) x (43560 ft^2 in an acre) x (0.5 liters/20 sec to fill)

   The next step is to determine the number of backpacks that will be needed to spray an acre. This is done by dividing the number of liters per acre by the amount of water held by the backpack. In our case the backpack sprayer held 20 liter of water. Therefore we needed (43 liters per acre/ 20 liter per backpack) 2.15 backpack to spray an acre.

   To determine how much chemical to add to each backpack full of water take the recommended amount chemical on a per acre basis and divide by the number of backpack needed to spray an acre. For example, if the chemical recommendation is 800 ml per acre, then the amount we to mix in one backpack is 800/2.15 = 372 mls per backpack filled with 20 l of water. If the recommendation on the label is in ml per ha, divide that rate by 2.47 which is the number of acres in a hectare.

Pesticide safety

Proper use of pesticides is important for the safety of the workers, consumers, environment and the community. Whenever using pesticides follow the following guidelines and other precautions found on the label of the pesticides.

1. All workers that use pesticides should be trained in their safe use
2. Those that apply pesticides should use protective clothing. Usually as a minimum this should include rubber boots, rubber gloves and eye protection.
3. Don't allow workers to enter fields that have been sprayed with insecticides until it is deemed safe to enter

4. Don't apply pesticide after the safe harvest interval.
5. Read and follow the label for approved uses and rates
6. Don't apply pesticides near water sources
7. Destroy empty chemical containers. Rinse and punch holes in these container so that no one will use them for carrying water.
8. Wash hands with soap and water after spraying. Change cloths and wash clothes that were used when spraying before using them again.

Fall Army Worm Control

Fall Army Worm has become a devastating pest of maize in Uganda. It was first identified in Africa as recently as last year. It was introduced from the Americas. It is especially problematic as it has no natural enemies (or they have not yet built up to useful levels), there is little resistance in current maize varieties/hybrids and the weather is conducive for this insect to cycle about every 40 days. Although the best way to control insects is through an integrated approach, there are few options other than insecticide for controlling this pest at the moment. The following are the recommendations for chemical control of Fall Army Worm.

1. Scout fields to determine the presences of Fall Army Worm larvae feeding in maize plants. The adult female lays her eggs on the leaves in the center of the maize plant. When the eggs hatch, the young larvae are small and will start feeding on the leaves. Usually at this stage they only feed on the surface of the leaves. If you see any evidence of feeding on emerging leaves you should prepare for spraying. Probably when about 5% to 10% of the plants are showing visible symptoms of feeding you should plan to make your first application.
2. Chemicals are more effective when larvae are small. Larvae also do less damage when they are small. An important recommendation is to spray when the larvae are small.
3. Do not spray with the same chemical twice in a row. Changing chemicals will reduce the rate at which resistance to the insecticide builds up in this pest. Be sure to use different chemicals not just different brands containing the same chemical.
4. There are numerous insecticides available in Uganda, but not all are effective against the Fall Army Worm. CRS will try and obtain a list of effective chemicals from the Ministry of Agriculture.
5. The best time for spraying is in the early morning, late afternoon or at night.