IRRIGATED PEPPER PRODUCTION

EXTENSION BULLETIN No. 240

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AKNOWLEDGEMENT

NAERLS wishes to acknowledge the financial support of Katsina State Government and FAO for the production of this bulletin. The bulletin has been updated with current information on the Pepper production under irrigation. Production and value addition of these perishable crops are of great importance to the well-being of our farmers.

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1.0 INTRODUCTION

Peppers are Vegetable crops belonging to the family of Solanaceae and genus Capsicum, which are native to tropical America and Africa. In Nigeria, pepper is mainly grown around the Savanna ecological zones as a crop mixture or mono crop both during the rainy season and dry season under irrigation. Pepper is an important vegetable consumed by human beings in Nigeria and is used in fresh form or as paste, pure and juice or ground with other vegetables in the preparation of stew and soup.

Although the crop is widely cultivated in Nigeria, the estimated yields of 9t/ha obtained on farmers' fields are often very low, compared with the estimated yields of 15t/ha obtained in Western Europe. The low yields obtained in Nigeria have been attributed to a number of production constraints that include problems of diseases, pests and poor weed management. Capsicum annum is popular and widely distributed in different ecological zones. It has two fruit types that are prevalent in the country and known by various local names. These are: Attarugu (Hausa) - Round shaped fruit and hot and Tattase (Hausa) - Bell shape fruit, mildly hot.

2.0 DESCRIPTION OF PEPPER CROP

Pepper (Capsicumannum) has its flowers borne singly in the leaf axils. When ripe, the fruits are red, yellow or brown, but immature fruits of the large mild kinds are often picked while still green for use in salads. These species are generally large - fruited. In contrast the flowers of capsicum fruitescens are borne in cluster of two or more in the leaf axils. The fruits are, in general, much smaller than those of Capsicum annum, bright red in colour and with a wide range of shapes and sizes. Pungency is again variable, but in general it is greater than in capsicum annum. The crop can be raised entirely under irrigation. Both the moisture content in the soil and the prevailing temperatures affect the growth and yield of pepper. The bulletin is aimed at providing practices and requirements for pepper production under irrigation.

3.0 VARIETIES

3.1 Varieties for Market

The most popular mild-fleshed pepper varieties for use as a fresh vegetable are 10.2 to 12.7cm long and have maximum diameters nearly as great as their length. They are typically three or four – lobed and tapered only slightly toward the blossom end (fig. 1). Some of the longer more tapering varieties are satisfactory for use in salads, but are losing in popularity because they are not so well suited for use in stuffed pepper dishes. Summary of the varieties is shown in table 1.

Figure 1. Florida Giant.

All the varieties except Neapolitan included in this group are dark green when immature and turn brilliant scarlet at maturity. They are generally used green (the Neapolitan, yellow), but sometimes they are used in the full-ripe stage because of the attractive red colour. Brief description of some of the more important varieties is presented. (The number of days given is the approximate time from transplanting to first harvest at the green – mature stage).

3.1.1 Burlington – Matures in about 75 days. Resistant to tobacco mosaic virus. Fruits
Similar to World Beater, medium large, oblong. A strain of World Beater developed for the use where tobacco mosaic virus is prevalent.

3.1.2 California Wonder – Matures in about 75 days. Fruit about 11.4cm long 9.5cm in diameter, mostly 4 –lobed, little or no taper, very smooth and attractive. Slightly smaller and earlier (65 to 70 days) strains of this type are also available under the name of early California Wonder.

3.1.3 Chinese Giant – Matures in about 82 days. Fruits about 11.4cm long, diameter nearly as great, 3 – or 4 – lobed, little taper, blossom ends tend to be crumpled and rough.

3.1.4 Florida Giant- Matures in about 75 days. Fruits similar to California Wonder but slightly larger and block shaped with little taper and smooth.

3.1.5 Keystone Resistant Giant – Matures in about 74 days. Resistant to tobacco mosaic virus. Fruits about 11.4cm long, 7.6 to 8.9cm in diameter, block shaped, somewhat tapered, ridged. Similar to Florida Giant.

3.1.6 Neapolitan – Matures in about 60 days. Fruits about 10cm long, 5cm in diameter, 3-lobed, tapered, yellowish green to greenish yellow when immature, bright red when mature.

3.1.7 Ruby king- Matures in about 68 days. Fruits up to 12.7cm long, 6.4 to 7.6cm in diameter, typically 3 – lobed, distinctly tapered, often irregular

3.1.8 Windsor – A – Matures in about 58 days. Fruits about 11.4cm long, 5.7cm in diameter, 3 – lobed, tapered only slightly except near blossom end, tend to be slightly crumpled or irregular.

3.1.9 World-beater – Matures in about 70 days. Fruits up to 12.7cm long, 9.5cm in diameter, distinctly 4- lobed, little taper, but not crumpled or irregular.

3.1.10 Yolo Wander – Matures in about 74 days. Resistant to tobacco mosaic virus. Fruits about 10cm long 7.6 to 8.9cm in diameter, block shaped, smooth. A strain of California wonder.

3.2 Mild Varieties for Processing

These varieties are by far the main canning varieties of pepper (fig. 2).

Figure 2. Perfection.

3.2.1 Perfection. Matures in about 80 days to red ripe. Fruits about 8.9cm long, 7.6 to 9.5cm in diameter, smooth and symmetrical, top shaped or short conical sometimes described as heart shaped, well-unused thick and firm, suiting the variety for canning.

3.3 Paprika Varieties. Practically all of the types of paprika peppers grown have been introduced from Southern Europe. Selections have been made for Colour, shape and thickness of pods, and flavour of the ground product.

3.3.1 Hungarian paprika- 5 to 12.7cm long, depending upon the strain, shapes vary from conical pointed to oblong tapering with a thin wall. When first introduced, some strains were slightly pungent, but non-pungent strains with improved flavor have been selected.

3.3.2 Spanish paprika - Fruit 12.7 to 22.9cm long, walls thin. Ground powder is bright red and has a very desirable flavour. The Spanish type is easily distinguished from the smaller Hungarian type (fig. 3). The large, thicker fleshed pods of the Spanish are the more difficult to dry successfully. The Spanish is also more

susceptible to disease in the field. These two disadvantages have limited the acceptability of the Spanish to growers in most localities.

Figure 3. Spanish paprika.

Table 1

S.N.	Variety	Maturity Period	Size	Shape
1	Burlington	About 75 days	Length Diameter 12.7cm	Medium large & oblong
2	California wonder	About 75 days	9.5cm 11.4cm	4 – lobed, little or no taper
3	Chinese Giant	About 82 days	9.5cm 11.4cm	3 or 4 – lobed, little taper, blossom end tend to be crumpled and rough
4	Florida Giant	About 75 days	9.5cm 11.4cm	Block shaped with little taper and smooth
5			9.5cm	

6	Keystone Resistant Giant	About 74 days	7.6cm 8.9cm 5.1cm	Block shaped somewhat tapered and ridged Shape vary from conical pointed to
7	Hungarian Paprika	-	12.7cm	oblong tapering Similar but larger than Hungarian
	Spanish paprika	-	12.7-22.9cm long	type

4.0 CLIMATIC REQUIREMENTS.

Peppers require more heat and are more sensitive to cold than most common garden crops grown in this country. Pepper will fail to thrive during cool periods when temperatures are between 4.4° to 15.6°C. Most varieties require a little more warmth than tomatoes – a daily average temperature of about 23.9°C. The larger, longer growing varieties, such as perfection, pimiento and Tobasco, require considerably more warmth. A few early varieties, such as early Giant and Windsor – A, can be grown successfully in many parts of the country especially in the Northern states. None are well adapted to the cool mountainous or high northern plains. At least 3 months of warm weather for plants in the field or garden are required for good yields of the earlier varieties adapted to the more northerly parts of the country, and 4 to 5 months for most other varieties.

Despite the pepper's need for plenty of warm weather, the extreme heat experienced in many parts of the country is too much for fruit setting in most varieties. Above 32.2°C blossom dropping becomes excessive, and many fruits that set at mean temperatures above 26.7°C are likely to be small or poorly shaped because of heat injury to the blossoms. Above 35°C few, if any, fruits will set, especially if the air is very dry or if there are dry winds. Fruit setting will begin again with the return of milder weather.

The small (10.0cm long x 7.6cm in diameter) to very small-fruited (10.0cm long x 5.0cm in diameter) varieties are more tolerant to hot weather than are the large fruited varieties. All large fruited varieties tend to drop many of the flowers that form after several fruits have started to develop on a plant. After some or perhaps most of these early fruits have been harvested, fruit setting will be resumed if weather and soil conditions are favourable.

In general maximum growth occurs in the temperature range of 21 – 27° c. Early blossoming and maturing of fruits are favoured by high temperatures, which also tend to reduce the setting of fruit. At later stages of blossoming, a lowering of temperature therefore result in enhanced fruit setting. Peppers require warm weather, but suitable varieties are available for all except the coolest parts of the country. They can be grown in any soil that is suitable for other vegetable crops, which is a well-drained, fertile soil of heavy loam type. Poorly drained soils can cause the plant to shed their leaves and to be susceptible to diseases, resulting in poor yields. Cultural requirements and practices are similar to those for tomatoes. The pepper plant, however, requires somewhat more careful handling and a little warmer weather (21 – 27°c) than does the tomato and it does not recover so well after unfavorable moisture, temperature or other conditions that retard growth.

5.0 SOILS AND FERTILIZERS

Good crop of peppers can be grown on any good soil. They are grown successfully on many kinds of soils, ranging from fine sands through many loams, clay loams, and silt loams, but sandy loams and loams are preferred. The soil must be well drained.

The pepper plant is not especially sensitive to soil acidity. Strongly acid soils, however, should be limed to a moderately or slightly acid condition (pH 5 – 6). If the soil is not naturally fertile, manures or green manures and inorganic fertilizers such as single super phosphate (SSP) and NPK compound fertilizer will need to be applied because a rich soil is necessary for producing high yield and good quality peppers. To maintain the soil organic

matter, 25 to 37.5 tons of stable manure compost, or green manure per hectare should be turned under annually.

Peppers should be fertilized in approximately the same way as tomatoes, but with a little more nitrogen and potash. It is perhaps even more important than with tomatoes to ensure that there is ample fertility to make th e plants start off and grow rapidly after transplanting lest they start blooming and set fruit while they are too small. Fruit setting on small plants definitely stunts their growth so that they fail to develop the plant size necessary to produce a good crop of fruit. Pepper plant generally makes rather poor recovery from any serious stunting

On loam and heavier soils of fair to good fertility, 250 to 500 kg/ha (5 to 10 bags) of compound fertilizer 15:15:15 should be thoroughly mixed with the soil along the rows, about a week before transplanting the plant. When the plants have set several fruits, additional nitrogen is needed to prevent the plant from slowing down in vegetative growth. At this time about 65kgN/ha should be applied as a top dressing near the rows and cultivated into the soil. On lighter sandy soils, 750 to 1000 kg/ha (15 to 20 bags) NPK 15:15:15 or 25-10-10 fertilizer should be worked into the soil before transplanting time, and a top dressing of about 65kgN/ha fertilizer should be applied at fruit –setting time. On these lighter sandier soils, 22.7kg of murate of potash should be added to the nitrogen during top dressing.

5.1 PEPPERS IN THE CROPPING SYSTEM

As peppers are grown in different parts of this country along with a large variety of other vegetable and field crops on individual farms, it is not practicable here to recommend specific crop rotation that includes peppers. More important than fallowing in particular rotation over many years is the precaution to avoid growing peppers on the same soil more often than once in 3 or 4 years. As tomatoes and peppers are subject to some of the same diseases, neither should follow the other in successive seasons in the same soil. Soil used for plant beds should have had no peppers grown in it for 4 or 5 years, preferably never before.

5.2 PROPAGATION

5.2.1 Planting in Place

Although much of greater part of the total hectarege of all kinds of peppers is grown from transplants, seed is sown directly in place in the open field, principally in some of the warmest parts of the country. 10 to 12 seeds can be planted 45cm apart on rows 75cm apart and later thinned when 8 to 10cm tall to 2 plants per stand. The costs of production by sowing in place are nearly the same as by transplanting, because of the costs for much more seed, thinning, and additional cultivation to control weeds. Sowing in place is not generally recommended, even in places where the season is long enough to permit its use.

5.3 Growing Plants for Transplanting

5.3.1 Large Scale Nursery Beds.

Many hectares of plant beds in the open field are used to grow pepper plants for sell to farmers. However, pepper plants are somewhat more difficult to grow, transport to long distance and deliver to the field in good condition for transplanting. Pepper plants are harmed more than tomato plants by unfavorable conditions in the plant bed, at transit, or upon delivery. Tansported plants therefore, are used for a smaller percentage of the total pepper hectarage than for the tomato hectarage.

5.3.2 Nursery Bed Management and Transplanting

The seedbed for raising seedlings is made 120-150cm wide and as long as necessary. The soil is pulverized by forking and breaking up the clods and removing stones and straw. After the soil has been loosened, add well-rotted manure or compost at the rate of three buckets per 6.0m^2 bed (fig.4) or compound fertilizer NPK 15:15:15 is applied at the rate of 22g/m^2.

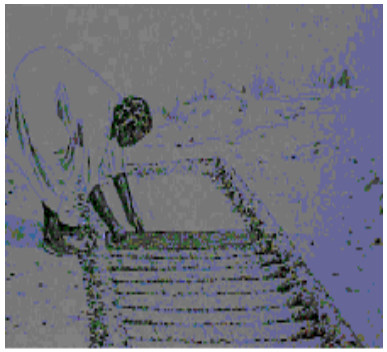

Figure 4. Addition of rotted manure to the seedbed. Figure 5. Place the seed in the row by hand.

Seeds are then sown thinly with fingertips into the rows or drills about 10 to 12cm apart (fig. 5). No special seed treatment is required other than that seeds should be extracted from a mature fruits, and should be well clean and properly kept before sowing.

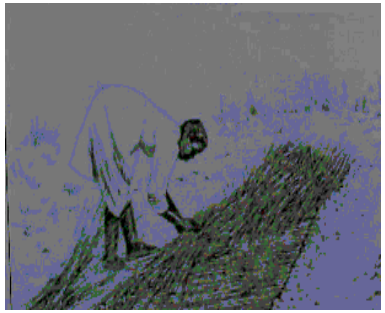

Figure 6. Use grass to mulch the nursery bed. Figure 7. Water the nursery bed with a watering-can.

After sowing, the bed is mulched by spreading dry grass evenly over the bed so that no light reaches the soil (fig. 6). Mulching is done to avoid rapid drying of the topsoil. The bed is then heavily but carefully watered so as not to wash out the seeds (fig. 7). Watering of nursery seedbed should always be done with a watering-can or a perforated tin. Put two watering-cans of water per 6.0m^2 bed, once a day. Reduce the amount three days before

transplanting to one can per day. This will harden the seedlings so that they can better overcome the shock of moving. When the seedlings emerge, the mulch is removed gently (fig.8).

Figure 8.Remove the grass mulch gently as soon as seedlings emerge.

In the rainy season, the beds should be raised about 15cm above the surrounding ground to enhance drainage and lowered during the dry season for water retention. For peppers grown during dry season, the nursery must be near a good source of water for irrigation, although peppers are able to withstand longer period of drought than tomatoes and eggs plants. Pepper can be planted towards the end of the rains, in September in northern Nigeria to make use of the residual moisture in the soil at that time, which can be supplemented with irrigation water during the flowering periods or when the rains ceases.

Ridge width for growing pepper may be 75cm –90cm, with an interplant spacing of 45 to 60cm. When planted on the flat, a closer spacing of 60 x 60cm may be adopted for sweet pepper (Capsicum annum). Seedlings should be uprooted with ball of earth using hand trowel. Transplanting on ridges of 75cm size should be spaced 45cm between plants (one plant per stand) to give plant population of 29,630 plants per hectare. For transplanting on flat, plots, of 6m x 4m is recommended, with plant spacing of 45cm apart in 60cm spaced rows. Transplanting should be done early in the morning or late evening to minimize transplanting shock. Six weeks old uniformly sized pepper

seedlings should be transplanted, and gap filling be done to replace missing stands about a week later.

6.0 IRRIGATION

Peppers, like many other vegetable crops, require a reasonably uniform soil – moisture supply during the growing season for best production. Long dry period may cause shedding of flowers and young fruits, and the plants are likely to make a rather slow recovery after drought injury. The most popularly used systems are basin and furrow irrigation system. Peppers are estimated to require between 600 – 800mm of water per season. An average of 15 to 20 irrigations are required to produce a crop of peppers depending on when irrigation season starts.

Furrow irrigation system is commonly used for applying water. In this method the pepper transplants are set at the side of the furrow at transplanting time.

7.0 WEED CONTROL

7.1 Manual Weed Control

No special methods are required in cultivating peppers. Shallow hand weeding, not more than 2.5 to 5.0cm deep is often enough to control weeds effectively. A total of three hand weeding at three weeks intervals commencing from three weeks after transplanting is enough to produce a good pepper. Care should be taken to avoid cultivation or other work on the soil when it is too wet. Repeated transplanting during successive harvests tends to pack the soil to an undesirable degree if it contains much clay or silt, especially when it is walked upon while the surface is wet. Pepper plant stems and branches are brittle and are more easily broken by wind or by farm implements than the stems and branches of most crops. Care should be taken to avoid striking or roughly pushing the plants about while working among them.

7.2 Chemical Weed Control

A number of herbicides have been found to consistently combine effective weed control with high yields, comparable with those achieved with hoe weeding. The most common weeds in

pepper plant nursery beds and production field are goosegrass, lovegrass, banyard grass, and pig weed. Examples of herbicides used for chemical weed control is presented below.

7.2.1 Chemical Weed Control in Plant Beds

The thick stand of peppers in seedbeds has made it difficult to effectively remove broad-leaved weeds and weed grasses. Large amounts of hand labour have been required, but now most of these weeds can be controlled with herbicides applied as soil fumigants before planting of peppers. An example of the chemicals used to control weeds in plant beds is methyl bromide.

Methyl bromide as a soil fumigant that controls weeds, fungi, bacteria and nematodes in the soil, is effective for the control of many weeds in plant beds. Prepare the soil as for seeding, omitting the final smoothing or compaction operation. Cover the area to be treated with an airtight plastic film. Burry the edges and support the center a few centimeters above the soil surface. Release the volatile liquid (Methyl bromide) at the rate of 276.8g per 10 square metres to be treated. The cover may be removed after 24 hours.

The chemical does not persist in the soil; hence sowing may be done safely 72 hours after removing the plastic cover. Soil moisture should be optimum for the rapid germination of weed – seed at the time of treatment and soil temperature should be 10^{o}C or above at a depth of 15cm.

Caution: Methyl bromide is a highly toxic gas. Follow carefully the precautions and directions on the container labels. Other soil fumigants available for pre-planting use are Furadan – 3G and Basamid. The soil is prepared for treatment as described above for Methyl bromide, and the chemicals are applied in water solution with a sprinkler, which can be followed by a light overhead irrigation to seal the soil surface. For most effective weed control, the weed seed germination soil temperatures should be 14^{o}C or above at the depth of 5cm.

7.2.2 Chemical Weed Control in Production Fields

In Nigeria for example, mixtures of alachlor (linuron plus chlobromuron) at 1.0 + 0.5 kg a.i./ha and 1.0 + 1.0kg a.i./ha respectively, and (pendimethalin plus metobromuron) at 2.0+1.0kg a.i./ha are effective in controlling weeds with a supplintary hoe weeding. Glyphosate at the rate of 4.0L/ha should be sprayed two weeks before land preparation to control stoloniferous and rhizomatous noxious weeds.

8.0 INSECT PESTS AND THEIR CONTROL

Peppers are attacked by many kinds of insects, the most important of which are aphids, cutworms, flea beetles, hornworms, the pepper weevil, pepper maggot, and leaf miners. Some of these insects are widely distributed; others are serious pests in limited areas only. Descriptions of few pests as examples are as follows**.**

8.1 Aphids

Aphids (or plant lice), notably the potato aphids, Macrosiphumeuphobiae (Thomas), and the green peach aphids, Myzuspersicae (Sulzer) are small soft-bodied insects found mostly on the underside of pepper plant leaves or on the stems and terminal clusters (fig.9). They are the most common and widely distributed of the insect pests of peppers. It is important to dust or spray the plants as soon as the first infestation is evident and as often as necessary thereafter. Controlling a light infestation is usually not difficult, but if control measure is neglected until the peppers are heavily infested, the damage may be serious and the success of the application doubtful. Aphids on peppers can be controlled with dusts or sprays containing endosulfan or with demton sprays. 0.5 to 1.0kg/ha of 25 percent endosulfan WP or 0.5 to 1.0litre/ha of 25 percent endosulfan EC, or 0.5litre square/ha of 25 percent demeton EC.

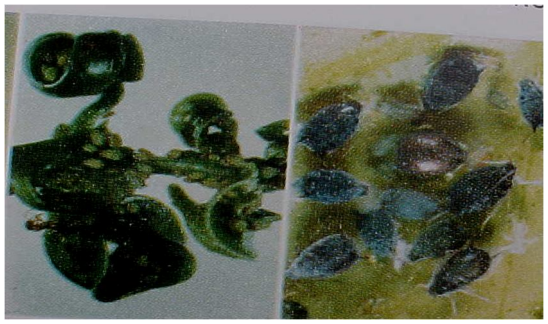

Figure 9. Aphids.

8.2 Cutworms

Cutworms attacking pepper plants, principally Feltiasubtenanea (Fabricus) and Pendromasaucia (Hubner), are stout, soft bodied smooth larvae, colored dark gray, brown or black sometimes spotted or striped (fig.10). Up to 3.8cm long, they curl up when disturbed. They cut off the young plants near the soil surface. Some cutworms climb plants and cut off the leaves and buds. They are found wherever peppers are grown.

Cutworms can be controlled by applying toxaphene as a dust or spray to the plants and to the soil around their bases at the rate of 2.268kg per hectare. A bait containing 3 percent of toxaphene in bran is effective when moistened with enough water to make a crumbly mash. Apply the bait to the soil around the young plants preferably in the evening, at the rate of 45.35kg/ha.

Figure 10. Cutworms.

8.3 European Corn Borer

The European corn borer, Pyraustanubilalis (Hubner), has become a serious pest of peppers grown. It is a small pale pink or brown caterpillar with a dark brown head (fig.11). The full-grown larvae are about 2.5cm long. It feeds within the stalks and pods. For control, spray each week with Cymbush E.C. or E.D. at the rate of 2L/ha.

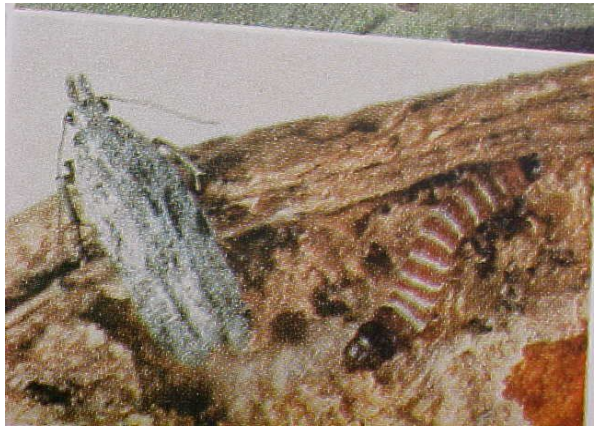

Figure 11. Corn borer adult and larva.

8.4 Flea Beetles.

Flea beetles, Exitrixspp, are small, black, brown, or striped Jumping beetles (fig.12). They damage peppers wherever this plant is grown. They feed extensively on the small plants and at the same times numerous enough to cause serious damage to large plants. Flea beetles can be controlled by applying a dust or sprayed at the rate of 1.2L/ha.

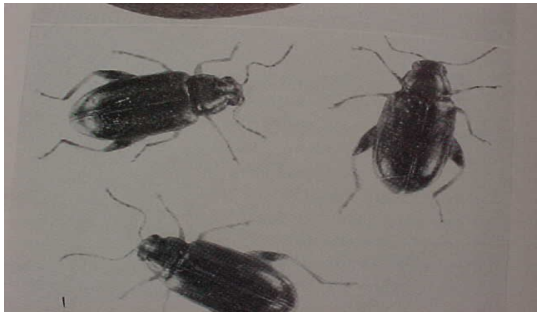

Figure12. Flea beetles.

8.5 Hornworms

The tomato hornworms Protoparcequinguemaculate (Hawarth), and the tobacco hornworm, P.sexta (Johanson), are large green worms with diagonal lines along the sides and a prominent horn on the rear end (fig. 13). They devour the leaves of pepper plants and when numerous may entirely strip them. Ordinarily in small fields they can be controlled by handpicking. For large fields, hornworms can be controlled by dusting or spraying with insecticides such as Cypermethrin and Dimethoate (Perfecthion) at the rate of 500mls/ha.

Figure 13. Tobacco hornworm. Left, larva on leaf. Right, adult moth resting on a leaf.

8.6 PEST CONTROL

6.6.1 Using Dust and Sprays

Insects infesting pepper can be controlled best by the use of insecticide dusts or sprays. These can be applied most effectively during calm periods of the day, usually early in the morning or late in the afternoon. Care should be taken to have the duster or the sprayer in good working order. See that none of the nozzles are clogged, and that they are properly adjusted at the right heights and angles so that all parts of the plants will be thoroughly covered with the insecticide (fig.14 & 15).

Figure 14. Ultra low volume (ULV) sprayer. Figure 15. Knapsack sprayer.

The rate of application will vary with the equipment, the size of the plants, and the type and strength of the material. In general, where the application is made with traction or power equipment, 28.35kg of dust or 567.5 to 1420 litres of spray per hectare is needed. When hand equipment is used and plants are small enough to be treated individually, 17 to 22.68 kg of dust or 567.5 to 681.9 litres of spray per hectare is sufficient. If emulsifiable concentrates are used, as little as 113.6litres of spray per hectare may be sufficient. Wettable powders require good mechanical agitation to prevent clogging of the spray nozzles.

9.0 DISEASES AND THEIR CONTROL

Peppers are subject to a number of diseases that reduce both field and market value of the fruit. Disease control is one of the most

important factors in the production of profitable pepper crops. The disease that most commonly cause losses of peppers are damping off, blue mold, bacterial spot, frog eye leaf spot, southern blight, phytophthora blight, fusarium wilt, anthracnose, mosaic disease, blossom-end rot, and sunscald.

Figure 16 Phytophthora blight

Diseases are classed as parasitic or non-parasitic. Most of the common diseases of pepper plants are caused by parasitic organisms, chiefly fungi. Other parasitic organisms attacking peppers are a few bacteria (represented in the above list by bacterial spot only and eelworms (notably the root knot nematode). Parasitic diseases must be controlled by the application of specific chemicals such as Ridomil and Dithane M45 (2-3kg/ha), Bavistin (1L/ha) as dust or sprays that will destroy the parasites or prevent their spread.

Virus diseases, although considered by some not to be caused by organisms, are usually thought of as parasitically induced. After fungi, viruses cause most of the diseases in peppers. Virus disease requires a clean

method of handling the plants and cultivating them, and paying attention to insect carriers.

So-called non-parasitic diseases are caused by unfavourable soil and climatic conditions (Poor environment). In the above list, blossom end rot and sunscald exemplify diseases caused by poor environment. The measures for control of non-parasitic disease are largely good cultural methods and the use of fertile, well-drained soils. Losses from many pepper disease can be avoided by the use of:

1 Clean seed protected by chemical treatment,
2 Seed bed sanitation
3 Crop rotation
4 Fungicides, bactericides, or insecticides applied to the plants as sprays or dusts, generally when needed.

Description of some few examples of important diseases and their control is given below. The summary of the description is presented below (Table 2).

Figure 17: Blossom end rot

9.1 Damping –off

9.1.1 Description

Damping off of pepper seedlings is caused by certain fungi Rhizoctoniasolani and Pythiumspp.; those often are present in the soil. These fungi may rot seed or kill the seedlings before they emerge from the soil. They also may attack the soft stems of the young seedlings after they emerge and cause water soaking and shriveling of the stem at the ground level. Plants attacked in this way soon fall over and die. Damping off is usually most damaging on very moist soil. Seedlings should not be over watered, particularly in cool, moist weather, and should be grown in rows far enough apart to allow plenty of ventilation to keep down the humidity.

9.1.2 Control

Treating pepper seed with certain fungicides to protect the young seedlings until they emerge from the soil can reduce losses from damping –off. This material includes preparations of such chemical as thiram. It should be used at the rate recommended by the manufacturers. The seed and chemical dust are placed in a tight container e.g. plastic Jeri can, which should not be over half of the container. They are then shaken together for 1 or 2 minutes. The excess dust is screened off and the seed is ready to plant. Damping –off in the seedbed (or fields) can be checked immediately after planting the seed by wetting the soil with a suspension of 2kg of captan to 455litres of water applied as a spray. This is applied at the rate of 4.5litres to each 11.6 square metre of soil. Ordinary wetting, perhaps by means of a sprinkling-can, is at the rate of 22.7litres to 9.29 square metre. Damping–off has been very severe in the seedbed, it can be controlled by chemically disinfecting the soil of the bed.

9.2 Blue Mold

Blue Mold, or downy mildew, occasionally causes serious losses of pepper seedlings. It is caused by fungus (Perronosporatabacina) that can develop and spread very rapidly in cool, moist weather.

9.2.1 Description

Pepper seedlings affected by blue mold show pale spot on the leaves. These spots become covered with a pale blue coating of fungus spores on their undersurface. Very young plants may be killed and the bed will look as though it had been sealed. On older plants infected leaves drop and the plant usually recover when the weather is again warm and dry.

9.2.2 Control

Blue mold can be controlled by spraying the seedbeds with preparations of ferbam or Zineb. Dusting with one of these materials also should check the disease. If blue mold appears in the vicinity, the seedlings should be treated before the disease occurs in the seedbeds.

9.3 Bacterial Spot

Bacterial spot causes severe problem to sweet peppers but is not a serious disease of hot peppers. The disease is caused by a bacterium, Xanthomonasvesicatortia that also causes bacterial spot of tomatoes. The most serious injury of peppers accurs on leaves and fruits. Stems are affected to a lesser degree.

9.3.1 Description

On young leaves the spots are small, yellowish green and slightly raised on the underside of the leaf. On older leaves the spots are first dark, water soaked, and not noticeably raised. When spots are few they may enlarge to 0.3 or 0.6cm in diameter. Such spots have dead, show- coloured centers with a darkmargin**.** When very numerous, the spots are brown, severely spotted leaves turn yellow and drop. Seedlings infected in the plant bed often lose all but the leaves at the top of the plant. Plants in the field also may lose many of their leaves.

On the fruit the small, blister like spots are roughly circular and may be 0.6cm in diameter. These spots turn brown and develop a cracked roughened, and warty appearance.

Figure 18: Bacterial Spot

9.3.2 Control

Control of bacterial spot in the seedbed is the best way to prevent losses in the field. Seedlings should be grown on soil that has not been planted to pepper for several years. If soil must be used in which peppers have been grown, it is safest to disinfect it with a suspension of 2kg thiran or captanto 455litres of water applied as a spray, at the rate of 4.5litres to each11.6m^2 of soil.

Pepper seedlings should not be transplanted to fields where peppers or tomatoes occurred the preceding year.

9.4 General Precautions

Chemicals that are used to kill fungi in the soil or used to kill fungi or bacterial of the pepper plants, or used to kill fungi of the seed, are injurious to man and animals if not handled with care. Therefore users should follow the precautions below.

1. Keep chemicals from getting into the mouth, eyes or nose
2. Do not allow the liquids to remain in contact with the skin, and wash promptly with soap and water.
3. When treating a large quantity of seed with a dust or when dusting plants in the field, wear a respiration or dust mask.
4. Avoid applications when there are drifting winds and avoid the disposal of chemicals into ponds, lakes and streams
5. Clean thoroughly all vessels used in preparing a spray solution.
6. Keep the chemicals in a safe place out of reach of children and pets.

Table 2 summarizes pepper diseases, description and their control.

S.N.	Disease	Description	Control
1	Damping-off	Damping off of pepper seedlings is caused by certain fungi Rhizoctoniasolani and Pythiumspp.; those often are present in the soil.	Treating pepper seed with certain fungicides to protect the young seedlings until they emerge from the soil can reduce losses from damping –off.
2	Blue Mold	These fungi may rot seed or kill the seedlings before they emerge from the soil. They also	This material includes
3		may attack the soft	preparations of such chemical as

	Bacterial Spot	stems of the young seedlings after they emerge and cause water soaking and shriveling of the stem at the ground level. Plants attacked in this way soon fall over and die.	thiram.
		Pepper seedlings affected by blue mold show pale spot on the leaves. These spots become covered with a pale blue coating of fungus spores on their undersurface.	Spraying the seedbeds with preparations of ferbam or zineb can control blue mold. Dusting with one of these materials also should check the disease. If blue mold appears in the vicinity, the seedlings should be treated before the disease occurs in the seedbeds.
		Very young plants may be killed and the bed will look as though it had been sealed.	Control of bacterial spot in the seedbed is the best way to prevent losses in the field.
		On young leaves the spots are small, yellowish green and slightly raised on the underside of the leaf. On older leaves the spots are first dark, water soaked, and not noticeably raised. When spots are	Seedlings should be grown on soil that has not been planted to pepper for several years. If soil must be used in which peppers have been grown, it is safest to disinfect it with a

		few they may enlarge to 0.3 or 0.6cm in diameter. Such spots have dead, show-coloured centers with a darkmargin**.** When very numerous, the spots are brown, severely spotted leaves turn yellow and drop.	suspension of 2kg thiran or captan to 455litres of water applied as a spray, at the rate of 4.5litres to each 11.6m^2 of soil.

9.5 Methods of Parasitic Disease Control

Non-parasitic diseases are caused by unfavorable soil or climatic conditions. The measures for their control are largely good cultural methods and the use of fertile, well-drained soils. Parasitic disease, however, must be controlled by use of resistant varieties or other biological methods or by application of specific chemicals that will destroy the parasites or prevent their spread. Fungicides and bactericides play a large part in reducing losses from parasitic disease

10.0HARVEST AND PREPARATION FOR MARKET

Mild- fresh or sweet peppers grown for fresh use should be harvested when they are at good marketable size (10cm long and 5cm in diameter) with dark green colour. They should be firm and crisp, but not so mature as to have begun losing their desirable greenness. Small young peppers are rather soft and yield readily to mild pressure of the fingers. Although quite edible at such stage, they are lacking optimum quality and food value. Growers who harvest soft fruit will not be getting the potential yield from their crops. In addition, because immature peppers are more subject to quality deterioration in the process of marketing, buyers may discount such fruit in price. The sweet peppers grown for canning

are harvested in both the mature – green and red-ripe stages. Most hot peppers are harvested red ripe for drying. Some however, are harvested either green mature or red ripe depending on whether they are to be sold for fresh use or for canning. The harvesting is usually done manually.

10.1 Picking

Peppers are generally broken from the plants with the stems left attached to the fruits. For sweet peppers strong cloth picking bags, which are suspended from the shoulders of the pickers are preferable to baskets or boxes. Both hands are free for rapid and careful removal of the fruit from the plants. Also hard picking containers may become rough and sandy and so cause damage to the peppers. Pepper fruits later carried to a central, point where they are graded and packed in standard baskets or put in containers for delivery to market or processing plant. The red-ripe peppers are sometimes sun dried and stored in bags.

11.0 CONCLUSION

Pepper production is a profitable venture for farmers in Nigeria due to its high market value. Achievement of peppers benefit by farmers depends on the crop management in both nursery and field. In addition to the climatic and soil conditions that favour pepper production farmers should be very careful to follow all the production requirements as stated in this Bulletin. Once the production stages are followed as described above, pepper (Capsicum annum) is expected to yield up to 15t/ha. Pests and diseases management is very essential in the production of pepper; therefore care should be taken to control their infection immediately to prevent their spread.

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