Study on Control of Bloaters in Gherkin (*Cucumis sativus* L.)

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ABSTRACT

The most severe problem in Gherkin (*Cucumis sativus* L) exportation is the presence of bloaters. A considerable portion of fruits rejected in the export market owing to this problem. Three experiments were conducted to study the reasons for initiation of bloaters. The effect of irrigation level was evaluated in the first experiment, using four levels of water. The influence of fertilizer composition and their levels on bloater formation was tested with four fertilizer mixtures having two levels of each. The involvement of pathogens was tested by culturing bloater tissues on artificial media. It was revealed that bloater percentage significantly increased under water stress conditions and recorded the lowest number of bloaters in treatment three (4.5l/vine/day). Fertilizer composition and their levels had no effect on bloater formation. Absence of any growth of a pathogen indicates that bloater formation is not associated with pathogens. Water stress is a key factor that affects bloater initiation in Gherkin.

KEY WORDS: Gherkin, Bloaters, Fertilizer, Irrigation, Pathogens.

INTRODUCTION

The Gherkin industry in Sri Lanka has rapidly developed over the last decade and contributes to 35-40% (Anon., 2002) of the foreign exchange from the export of horticultural products. In year 2002, Sri Lanka has exported 4947mt of Gherkin valued at Rs.31.1 million (Anon, 2002), mainly to countries such as Japan, South Korea, Australia, Spain, Netherlands, Taiwan.

Among vegetables, Gherkin is the main item that is exported in both semi-processed and processed forms. Currently Gherkin is grown in commercial scale under the buy back system with out-growers (Kumara *et al.*, 2003). A potential exists to expand this industry further targeting the export market. However, there are several constraints, which adversely affect on Gherkin production in the export market.

One of the major problems associated with Gherkin is the presence of bloaters. A bloater is a hole formed inside the Gherkin fruit and it could be developed either during the processing period or in the farmer field.

Two types of bloaters have been identified in the farmer fields, based on the shape of the hole, namely, Honey Comb Bloaters and Balloon Bloaters.

Honey comb bloaters are the most common form and 35% occurrence could be seen in the field. Two to four holes starting from the stem end of fruit run parallel to the longitudinal axis and extent up to 1/3 of the distance from stem end.

Balloon bloaters are more severe than Honey comb bloaters. It is a large balloon like hole extending to the central axis of fruit.

The bloater percentage in Gherkin should be less than 5% in the export market to avoid rejections. However, at present 35% of bloater level is recorded under field condition in Sri Lanka. Since this has become critical issue in the export market. Identification of causes and management of bloaters in Gherkin is of a vital importance to expand the industry.

Several reasons are suspected to be the causes of bloaters in Gherkin, namely, Physiological stresses such as pH, water, fertilizer and soil type, fungal infections, variety and pollination problems.

Therefore, present study was conducted to ascertain the causes of bloater formation and to develop methods of managing it.

MATERIALS AND METHODS

1. Evaluation of the effect of irrigation level on bloater formation

The experiment was carried out at Kumbukgate area located in Low Country Intermediate Zone (IL_1) from November 2004 to February 2005. The soil type available was Low Humid Glay soils (De Alwis and Panabokke, 1973).

In all experiments (one, two and three) Vlasset variety was used and five days old seedlings were transplanted to 15cm height raised beds at the spacing of 100cm×45cm. Pest management and other cultural practices were carried out according to the recommendation of Sunfrost limited for Gherkin cultivation. Fruits of 3.5-4.5cm size were harvested daily for 35 days after crop establishment.

Plants were established under a rain shelter made of 1000 gauge polythene roof. A lower head drip irrigation system with elevated water tank and lateral lines with 30cm distance were used. Manual valves were used to control the amount of water for each treatment and irrigation was calibrated by time and flow rate per each treatment. Seventeen plants were arranged in a bed for trellis culture. Four irrigation levels were used as four treatments.

T_1: 1.5 l /vine/ day
T_2: 3.0 l /vine /day
T_3: 4.5 l/ vine /day
T_4: 5.5 l /vine/ day

The experiment was laid out in a Completely Randomized Design (CRD) with three replicates.

Total number of fruits, fruits with bloaters, bloater percentage per each treatment, and average yield per plant were evaluated daily for 35 days after crop establishment.

2. Evaluation of the effect of fertilizer mixtures and their levels on bloater formation

The experiment was carried on an open field in Kumbukgate area located in Low Country Intermediate Zone (IL_1) from November 2004 to February 2005. The soil type available was Low Humic Gley soils (De Alwis and Panabokke, 1973). A lower head drip irrigation unit with sixteen laterals (12mm diameter) at 45cm distance was used to discharge water at the rate of 6.4 liters per hour. Manual valves were used to control irrigation.

Four fertilizer mixtures were used as main factor (Table 1) and two fertilizer levels namely the recommended dosage and 75% of the recommended dosage were used in the sub plots. Main factors had three replications and fertilizer levels were used in the sub plots with two replicates, each containing minimum of seventeen plants.

Table 1: Composition of the fertilizer mixtures used

Main factor (Fertilizer mixture)	Rates of fertilizer (kg/ha)		
	Nitrogen (N)	Phosphorus (P_2O_5)	Potassium (K_2O)
T_1	100	84	129
T_2	158	84	160
T_3	158	84	129
T_4	100	84	160

Total number of fruits, fruits with bloaters, bloater percentage with different fertilizer mixtures and their levels, average yield per plant and yield per each treatment were evaluated daily for 35 days after crop establishment.

3. Study on the possible causal organisms of bloater formation

Field experiment

The experiment was carried out at the Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila located in Low Country Intermediate Zone (IL_1) from May to July 2005.The soil is moderately well drained soft lateritic subsoil (De Alwis and Panabokke, 1973). A lower head drip irrigation unit with 30 laterals (12mm diameter) at 45cm distance was used.

Laboratory investigation

Potato Dextrose Agar (PDA) medium was used to isolate any possible causal organisms from the tissues of Gherkin fruits affected by bloaters. Isolated cultures were prepared according to the following four methods.

1. PDA medium with streptomycin and with the surface sterilization of tissues.
2. PDA medium with streptomycin and without the surface sterilization of tissues.
3. PDA medium without streptomycin and with the surface sterilization of tissues.
4. PDA medium without streptomycin and without the surface sterilization of tissues.

PDA, Glassware and other equipment used were sterilized by using methods recommended by the Commonwealth Mycological Institute (CMI) (Johnston and Booth, 1983).

Cultured tissues were maintained for three days in order to detect growth of possible causal organisms.

Statistical analysis

Statistical Analysis System (SAS) was used to analyze data of first and second experiments.

RESULTS AND DISCUSSION

1. Evaluation of the effect of irrigation level on bloater formation.

Table 2: Bloater percentage and average yield under four irrigation levels

Irrigation level (liters/vine/day)	Bloater (%)	Average yield (kg/vine)
T_1 1.5	19.7	2.2
T_2 3.0	12.8	2.4
T_3 4.5	10.4	2.8
T_4 5.5	18.1	3.2

Bloater percentages under four irrigation levels were analyzed by Kruskal-walis procedure. According to that analysis the bloater percentage was significantly influenced by the irrigation levels (probability 0.017). The highest bloater percentage (19.7) was resulted in T_1 (1.5l/vine/day) whereas the lowest value (10.4) was reported in T_3 (4.5l/vine/day) Bloater percentage had increased in treatment one and treatment four, while treatment two and treatment three showed lower bloater percentage. The bloater percentage was increased at lowest (T_1) and highest (T_4) water levels (Table 2).

2. Evaluation of the effect of fertilizer mixtures and their levels on bloater formation

Table 3: Bloater percentage and average yield under two levels of fertilizer mixtures

Fertilizer mixture	Fertilizer level (%)	Bloater (%)	Average yield (g/vine)
1	100	22.4	773
1	75	28.9	602
2	100	23.6	729
2	75	21.1	403
3	100	21.0	980
3	75	25.7	519
4	100	23.9	999
4	75	18.8	504

Bloater percentage and average yield under four fertilizer mixtures and their levels were given in Table 3. According to the results of Kruskal-walis procedure there was no significant relationship between different fertilizer mixtures and bloater percentage, and also there was no significant difference between bloater initiations in two different fertilizer levels (probability 0.5892).

Under recommended dosage, bloater percentage varied from 21 to 23.9, and under 75% of the recommended amount bloater percentage varied from 18.8 to 28.9.

In treatment one and three 75% dosage indicated higher bloater percentage (28.9 and 25.7) than recommended level, whereas in treatment two and four recommended dosage indicated higher bloater percentage (23.6 and 23.9) than 75% dosage.

According to the table 3, fruit yield varied from 729g/vine to 999g/vine in recommended dosage. Treatment four gave the highest yield (999g/vine), while treatment two gave the lowest yield (729g/vine). Approximately, similar yield was recorded in treatment three and four and also in treatment one and treatment two. Yield per plant was increased with the fertilizer mixture three and mixture four. When fertilizer dosage was reduced up to 75%, yield was also decreased in all treatments. When 25% of fertilizer reduced from the recommended amount, 30% of yield reduction occurred.

3. Study on the possible causal organisms of bloater formation

Table 4: Results of cultures

Medium	Streptomycin	Surface sterilization	Pathogen growth
PDA	Added	Done	No
PDA	Added	Not done	No
PDA	Not added	Done	No
PDA	Not added	Not done	No

Cultures on all types of media did not show any growth of a microorganism.

CONCLUSIONS

Experiment one revealed that the level of irrigation plays a major role in initiating bloaters in Gherkin. Bloater percentage increases under water stress conditions, both at scarcity and excess water. Bloater percentage could be reduced up to 10.4% with application of 4.5l of water/vine/day.

Experiment two indicated that the formation of bloaters does not depend on tested fertilizer compositions and their levels.

It was clear from the experiment three that there is no pathogen involvement in bloater formation.

It can be concluded that, certain environmental stresses such as water stress have a significant impact on bloater formation in Gherkin. 4.5l/vine/day can be reduced bloater percentage up to 10.4. Further studies should be carried out to reduce the bloater percentage below 10.4 in long term basis.

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