

Crop damage by urban environment in Malaysia

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Abstract—Environmental pollutants are causing worldwide damage to plants, forests and crop production, among which, gaseous and particulate metal pollutants from heavy industries in many developed countries are of major concern. Many of these pollutants kill plants, cause stunted growth and premature aging, inhibit flowering and fruiting, cause a reduction in dry matter, and thereby results in a great reduction in crop production in many countries. This paper describes how an urban environment in Malaysia which is an agricultural based country affects plant growth and crop production.

Keywords: crop damage; urban environment; Malaysia.

INTRODUCTION

During the past few decades, crop damage or low production is no more confined to plant pathogen like micro-organisms, animals and plants but also by environmental pollutants. It has become a common headlines in many newspapers such as "Global warming effects on rice yields" and "Air pollution harming forests, crops" (Business Times, 1988).

Prof. James J. MacKenzie, of the World Resources Institute, Washington, co-author of the institute report entitled "I11 Winds: Airborne Pollution's Toll on Trees and Crops" said in a press conference in Washington in 1988 that there was evidence that air pollution was contributing to the death of forest trees and to widespread loss in crop productivity in the US. high levels of ozone, one of the major culprits in crop damage, cost American farmers approximately US\$ 3 billion last year in lost yields of corn, soybeans, wheat and peanuts. As is seen there is a widespread concern on the destruction of crops and forests by environmental pollution among the researchers, in developed countries.

Malaysia is a developing country and is growing very fast each day. The problem of environmental pollution is also catching up on us. Being an agricultural based country where the major revenue is based on rubber, palm oil, timber, tea, coffee and cocoa. Crops and forests destruction by environmental pollution is also of our main concern, although most of researches carried out in this area are still in their infancy. The Ministry of Environment, Science and

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Technology of Malaysia together with many research institutions are working very closely to tackle this problem before it gets out of control.

The effects of city environment on plants, crop yields, and especially on the damage caused by metal pollutants such as Cd and Pb, which are associated with the emissions of the motor vehicles, were investigated.

MATERIALS AND METHOD

A tropical ornamental flowering plant, *Impatiens balsamina*, commonly known as balsam, which grows easily in this hot and wet tropical climate is used in this study because the plant completes its life-cycle in approximately seven months. For each set of experiment, about five to six hundred plants were grown simultaneously in the urban locations with high traffic density and rural locations far from any major high-ways. Daily climatic parameters and physical parameters of water and soil of these locations were observed carefully and growing procedures between locations were kept similar. When the plants were ten weeks old, flowers from a group of fifty plants were collected and the dry-weight of the flowers were noted after drying. This procedure was carried on at an interval of every one week. For percentage yields of fruits the procedure was similar except the fruits, instead of the flowers, were collected. The fresh-weight and dry-weight of the other parts of the plants were also measured.

Two tropical crops, *Mainhot esculent*, a root crop and commonly known as tapioca; and *Zea mays*, a seed crop and commonly known as sweet corn, were also grown in these urban and rural locations. At harvesting, for tapioca, the storage roots from equal number of plants from each location were harvested and fresh weight were determined after appropriate cleaning. As for sweet corn, the corns were collected from equal number of plants from each location and the corn kernels were weighed after removing the outer husks.

RESULTS

Balsam plants grown in the urban environment especially areas with high traffic-density were normally found to be shorter, with smaller leaves and fruits, barbed-wire roots, premature senescence and enhanced maturity. Table 1 presents the percentage of fresh-weight of various plant parts of the urban grown balsam plants to that of the rural grown balsam plants of 12 weeks old. Comparison on dry-weight bases is also given in Table 1. The results show an overall growth reduction for the urban grown balsam plants and reduction in both fresh-weight and dry-weight of various plant parts for the urban balsam plants.

Table 1 Influence of the urban and rural environment on the fresh-weight and dry-weight of *impatiens balsamina* at 12 weeks old

	Fresh-weight of urban plants	Dry-weight of urban plants
	Fresh-weight of rural plants	Dry-weight of rural plants
Whole plant	72.3	65.6
Leaves	71.2	59.7
Stem	75.9	69.1
Roots	80.1	66.8
Flowers	69.3	64.2
Fruits	60.6	56.1

Effects of urban environment on crops are clearly seen from the decreased yields of tapioca roots and of the sweet corn kernels (Table 2). Besides reduction in yields, the plants did show slightly stunted growth in appearance although the measured results of plant heights were not really significant.

Table 3 shows that the yields of the urban grown balsam plants were greatly decreased because of smaller fruit size and premature senescence.

Table 2 Effects of urban and rural environment on crop yields of tapioca and sweet corn

Crops	Yield* (fresh-weight), %
Tapioca roots	80.2
Sweet corn kernel	75.8

* fresh-weight of urban crop/fresh-weight of rural crop.

DISCUSSION

Pollutants especially air pollutants such as ozone, sulphur dioxide, oxides of nitrogen are well known to have adverse effects on plants that there had been occasion where a complete destruction of vegetation occurred as at Ducktown, Tennessee (Seigworth, 1943). Many cultivars of economic crop plants were known to be injured by ozone (Manning, 1974; Heggstad and Heck, 1971; Feder, 1970). Commonly affected plants in USA include cultivars of bean, onion, potato, spinach, squash and tobacco. Symptoms of injury range from leaf yellowing to extensive necrotic flecking and blotching, impaired plant growth and development, premature senescence, enhanced maturity and yields reduction by as much as 20 to 25% (Manning, 1974; Linson, 1971; Bell, 1979). Tingey and Reinert (1975) in their study on the effects of ozone and sulphur dioxide on *Nicotiana tabacum* found reduction in dry-weight of leaves up to 22%. Bell *et al.* (1979) found there was a reduction in yield up to 25% in *Lolium perenne* when the plants were exposed

Table 3 Comparative yields of balsam plants grown in urban and rural environment

Age of plants, weeks	Average yields for every 50 plants by age of plants*										Average total yields											
	10	11	12	13	14	15	16	17	18	19		20	21									
Dry-weight of flowers, g	Urban	3.9	4.6	5.2	4.9	3.7	0.1														24.4 [†]	
	Rural	3.0	5.9	8.1	8.9	8.1	7.2	6.4	5.1	3.9												56.6 [†]
Yield, %	Urban	130	78	64	55	46	1															40
Dry-weight of fruits, ×10 ⁻¹ g	Rural	2.5	7.4	15.5	23.1	27.9	10.1															115.6 [†]
Yield, %	Urban	2.1	13.2	27.3	38.5	45.2	59.4	60.3	61.7	60.2	48.1	20.9										436.9 [†]
	Rural	119	56	57	60	62	49	19														26

* Average per five replications, fifty plants each.

† The values are significantly different ($p = 0.01$) using Duncan's multiple range test

to low level sulphur dioxide. Wong *et al.* (1986) on their study of the effects of lead, cadmium and copper on a tropical vegetable, *Brassica chinensis* found that these metals affect the growth of the plants. Many plants were tolerant to heavy metals but these plants were normally found to have a lower biomass production (20-50% lower) after exposing to heavy metals (Ernst, 1976).

All these pollutants are found in a city environment with heavy industries and heavy traffics. As seen in this work the city environment did not favour the healthy growth of plants. Although the plants survived but they were injured or damaged. Stunted growth, reduction in weight, and reduced yields were noticed. The effects would be critical for economic plants grown in the environment filled with many types of pollutants.

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