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# Assessing Vegetable Farmer Knowledge of Diseases and Insect Pests of Vegetable and Management Practices Under Tropical Conditions

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In order to understand management of vegetable pests under tropical conditions, farmer knowledge of pest etiology and epidemiology was investigated in Mar. 2009. About 78% of vegetable farmers were men aged 31–40, with 51% having little formal education. About 21% of farmers can identify diseases and 16% can identify insects. Over 80% grow susceptible varieties. Ninety-two percent of farmers used synthetics pesticides. About 92% were willing to accept resistant varieties. This willingness provides a basis for further collaboration to employ resistant varieties and promote integrated pest management.

***Keywords*** Cameroon, Chemicals, Crop production, Pesticide.

A minimum consumption of 200 g/day/person, 73 kg/person/year, of vegetables is recommended (Food and Agriculture Organization, 2004). Presently, vegetable availability is 50 kg/person/year and in sub-Saharan Africa (SSA), and vegetable consumption is only 43% of recommended rate (Food and Agriculture Organization, 2004). Vegetables are important sources of micronutrients and provide farmers with higher income·per hectare than cereal, root,



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and tuber crops (Asian Vegetable Research and Development Center [AVRDC], 2006).

Vegetables form part of a healthy diet because they provide vitamins and minerals. Biotic and abiotic factors are among the major constraints of vegetable production. Many tropical locations receive high rainfall per year that contributes to high disease incidence on vegetables (Bowen and Kratky, 1982). Rain, heavy dews, warm temperatures, and dry climates (mostly for insect infestation, which is affected by rain) have been reported as principal conditions that favor establishment of pests (Landston and Eaker, 2009). Iwuchukwu and Uzoho (2009) indicated that the most important financial constraints associated with vegetable production in Enugu State, Nigeria, were caused by the laborious nature of vegetable production and incidence of diseases and pests. Youdeowei (2002) also indicated that biotic constraints caused significant economic loss on vegetable in Ghana. In Cameroon, pests and diseases have been identified as major constraints to vegetable production (Ellis-Jones et al., 2008). Pests and diseases cause both economic and health problems for vegetable farmers.

Chemical control is practiced by farmers for higher gains (Gerken et al., 2001), but these pests can become resistant to chemical insecticides very quickly. Moreover, the misuse of chemical insecticides in terms of quantity applied or in dangerous combinations (Obeng-Ofori et al., 2002) has created problems including pest resistance, resurgence of pests, pesticide residues, destruction of beneficial insects, and environmental pollution (AVRDC, 2003). A survey of pesticide application in Cameroon conducted by Matthews et al. (2003) to manage crop pests and diseases reported illnesses caused by the use of pesticide. In a resource-poor farming system, strategies for pest management become more complicated. The sociological diversity in Africa contributes to disparate traits that farmers' value in varieties grown. It is necessary to understand why farmers continue to use certain crops and cropping practices before suggesting improvements in management of pests (Kiros-Meles and Abang, 2007).

This study was undertaken to determine knowledge of pests and diseases and their management and to determine socioeconomic demographics of producers. Specifically, the objectives were to determine farmers' experience in pest and disease identification, management, and information needs. The data varied due to differences in knowledge, understanding, sex, age, family status, and level of education (Caulkins and Hyatt, 1999).

## MATERIALS AND METHODS

Sampling sites were in vegetable production regions and determined by use of multilocation random sampling. The sample size for each region was determined based on its share of total national vegetable production. The

regions surveyed and sample size were as follows northwest (21 farmers); west (49 farmers), southwest (34 farmers), central (38 farmers), littoral (19 farmers), south (18 farmers), and east (15 farmers). The AVRDC crops used in the Vegetable Breeding and Seed System program were as follows: *Amaranthus* spp. (amaranth), cabbage (*Brassica oleracea* var. *capitata* L), pepper (*Capsicum* spp.), onion (*Allium cepa* L.), jute mallow (*Corchorus olitorius* L.); African nightshade or huckle berry (*Solanum scabrum* Miller), eggplant (*S. melongena* var. *esculentum* Nees), tomato (*Lycopersicon esculentum* L.), and okra (*Abelmoschus* spp.). Tools used to obtain information about farmers' perceptions and knowledge related to vegetable crop pests were open-ended questions administered in a semistructured questionnaire allowing data to be gathered in the farmers's cultural context (Björnsen-Gurung, 2003). The questionnaire contained 38 main questions. Ten farmers participated in the prestudy (pilot study) to insure farmer comprehension of typical questions and the ability of enumerators to administer it. Their responses were used to improve the final copy.

A codification manual was prepared and numbers ranging from 1 to 6 assigned to responses, depending on the number of responses expected per question. This codification was used to enter farmers' responses in Census and Survey Data Processing system software (Ver. 3.3, Census Bureau and ICF Macro, Washington, DC). The data in Census and Survey Data Processing system software were imported into Statistical Package for Social Sciences software (SPSS, Ver. 17.0.1, Chicago, IL) for editing and analysis, and Excel was used to produce figures. Descriptive statistics were used to determine frequencies of responses.



## RESULTS

The total number of farmers interviewed was 194; 96% of them produced vegetables for market and 4% produced for both the market and home consumption. About 64% produced vegetables in rural areas, 32% in peri-urban areas, and 7% in urban areas. The categories of vegetable farmers varied between age, sex, family status, and level of education (Figure 1). Seventy-eight percent of vegetable farmers were men and 22% were women. Most (77%) were household heads.

### Experience in Crop Management

Tomato, hot pepper, okra, and cabbage are important regional crops in Cameroon (Figure 2) and are produced in different locations (Table 1). Producer experience in vegetable cultivation varied (Table 2). All land holdings were small (Figure 3).

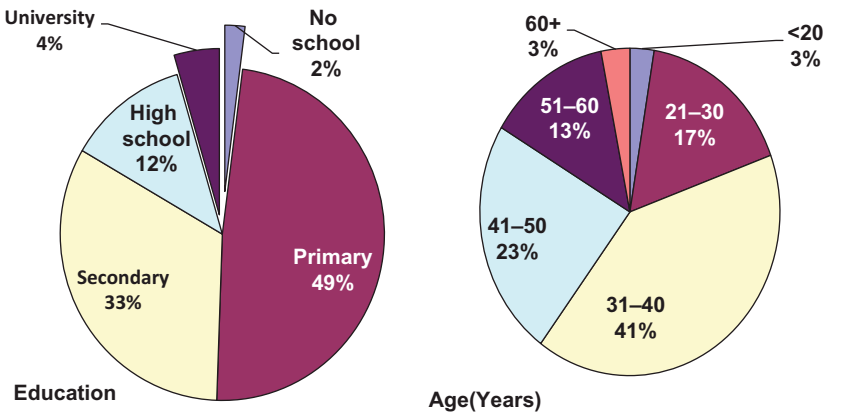


**Figure 1:** Age groups and level of education of vegetable farmers.

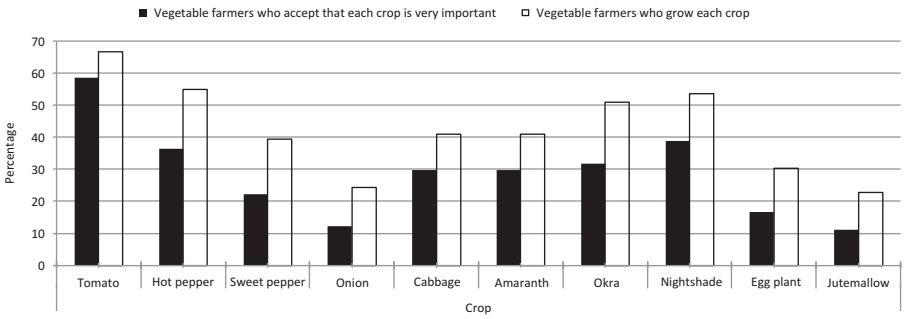


**Figure 2:** Comparison between farmers who consider each crop as very important and total percentage of farmers who grow each crop.

## Knowledge of Insect Pests and Diseases

All famers recognized the so-called mildiou (late blight) caused by *Phytophthora infestans* (Mont.) de Bary of tomato; the soil-borne bacterial wilt caused by *Ralstonia solanacearum* (Smith) on most solanaceous species; and aphids, which they can describe by symptoms on crops. The term "flies" was used as a general name for all insect pests that fly; they were able to differentiate between white flies and flea beetles from their color. Most defoliators and fruit borers were generally called caterpillars, which could only be differentiated from feeding habits described by the farmer. Only 18% of respondents were able to identify vegetable pests. When all pests were placed on the same scale, insect pests appeared to be more important than diseases (Table 3). According to respondents, eggplant and jute mallow did not have serious insect pest problems.

About equal numbers could or could not identify sources of pests and diseases on their farms (Table 4). Generally they could not predict disease

**Table 1:** Percentage of farmers who identified each crop as important by location.

| Region | Site | Tomato | Hot pepper | Cabbage | Okra | Nightshade | Sweet pepper | Onion | Amaranth | Eggplant | Jute mallow |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Central | Bafia | 100 | 60 | 88 | 71 | 79 | 67 | 33 | 0 | 67 | 71 |
| | Obala | 100 | 0 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Yaounde | 94 | 0 | 50 | 0 | 100 | 92 | 0 | 100 | 67 | 0 |
| East | Bertoua | 100 | 33 | 0 | 75 | 60 | 67 | 0 | 50 | 0 | 0 |
| | Abong-mbang | 100 | 86 | 40 | 40 | 50 | 60 | 0 | 0 | 0 | 0 |
| Littoral | Douala | 20 | 43 | 33 | 67 | 86 | 0 | 0 | 0 | 0 | 0 |
| | Njombe | 33 | 89 | 100 | 67 | 100 | 0 | 0 | 0 | 0 | 0 |
| Northwest | Santa | 50 | 100 | 100 | 100 | 60 | 25 | 0 | 100 | 100 | 50 |
| | Ndop | 100 | 100 | 100 | 50 | 60 | 75 | 33 | 100 | 100 | 100 |
| South | Ebolowa | 91 | 40 | 33 | 36 | 30 | 50 | 0 | 20 | 33 | 0 |
| | Ambam | 83 | 50 | 0 | 0 | 100 | 33 | 0 | 0 | 0 | 0 |
| Southwest | Buea | 100 | 100 | 100 | 80 | 100 | 100 | 100 | 100 | 100 | 83 |
| | Ekona | 100 | 100 | 100 | 67 | 33 | 75 | 0 | 88 | 80 | 50 |
| | Muyuka | 33 | 40 | 88 | 57 | 100 | 33 | 0 | 0 | 71 | 33 |
| West | Dschang | 43 | 12 | 73 | 29 | 55 | 0 | 94 | 50 | 0 | 20 |
| | Bangante | 100 | 100 | 0 | 67 | 67 | 100 | 100 | 100 | 100 | 0 |
| | Foumbot | 100 | 88 | 67 | 92 | 89 | 82 | 100 | 73 | 100 | 0 |

**Table 2:** Farmer experience in market gardening.

| District | Years in agriculture | Years in market gardening |
|---|---|---|
| Bertoua (east) | 17.4 | 14.9 |
| Buea (southwest) | 19.6 | 14.2 |
| Douala (littoral) | 20 | 10 |
| Ebolowa (south) | 10.9 | 8.3 |
| Ekona (southwest) | 11.8 | 7.8 |
| Upper Nyong (east) | 19.1 | 6.7 |
| Lekie (central) | 18.0 | 11.8 |
| Mbam Ekim (central) | 11.7 | 8.0 |
| Menoua (west) | 14.6 | 9.1 |
| Mezam (northwest) | 23.3 | 22.8 |
| Mfoundi (central) | 18.2 | 16.3 |
| Moungo (littoral) | 15.3 | 21.6 |
| Muyuka (southwest) | 15.9 | 14.0 |
| Nde (west) | 19.5 | 13.8 |
| Ngoketunjia (northwest) | 27.9 | 16.3 |
| Noun (west) | 15.7 | 13.9 |
| Ntem valley (littoral) | 9.0 | 5.7 |



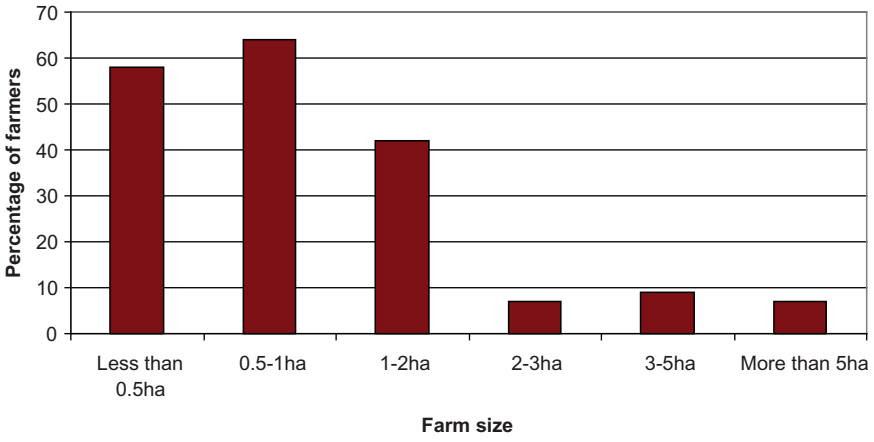


**Figure 3:** Farm size distribution used for vegetable production.

outbreaks. They recognize disease problems when they can describe symptoms or when it is necessary to abandon fields for new sites. Generally they believed that all pests and disease problems in vegetable fields are not new. Most grow susceptible varieties and few stated that production of some vegetable crops and cultivars declined or were not able to be produced as a result of pest or disease problems. The varieties cultivated are not resistant. However, almost all respondents were willing to accept resistant varieties provided that the varieties have important traits (Figure 4).

**Table 3:** Percentage of growers who identified specific pests as a constraint in the production of vegetable crops.

| Pest type | Pest | Tomato | Hot pepper | Cabbage | Okra | Nightshade | Sweet pepper | Onion | Amaranth | Eggplant | Jute mallow |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Insect | Unknown | 66.9 | 87.6 | 92.2 | 89.2 | 86 | 93.7 | 99 | 93.8 | 98.8 | 98.3 |
| | Ants | 1.3 | 0.9 | | 1.3 | 3.2 | | | 4 | | 1 |
| | Aphids | 4 | 2.7 | 3 | 2.5 | 4.5 | 1.7 | | 1 | 0.5 | 1 |
| | Beetles | | | | 2.8 | 2 | 0.5 | | 4.5 | | 0.5 |
| | Caterpillars | 18.5 | 6.1 | 4.8 | 2.9 | 3.3 | 1.8 | 0.5 | 2 | 0.8 | 0.5 |
| | Cricket | 3.5 | | | 2 | | 0.8 | 0.5 | 1.7 | 1 | 0.5 |
| | White fly | 9.3 | 2.7 | | | | 2.9 | | 1.8 | 0.8 | |
| Disease | Unknown | 70.7 | 93 | 97.9 | 9.6 | 95.2 | | | | 99.5 | 99.5 |
| | Blight | 14.5 | 3.8 | 4 | 1.8 | 5.4 | 1.3 | 0.5 | 2 | 0.5 | 1 |
| | Viruses | 0.8 | 2 | | 1.5 | 3 | 0.5 | | | | |
| | Bacteria Wilt | 4.2 | 1 | | 1.5 | 0.7 | | | | | 0.5 |

**Table 4:** Sources of pests and disease identified by vegetable farmers.

| Source | Percentage |
|---|---|
| None | 44.4 |
| Climate change | 8.6 |
| Manure | 0.5 |
| Humidity | 15.3 |
| No treatment | 7.5 |
| Poor seed | 2.0 |
| Soil borne | 12.1 |
| Surrounding vegetation | 7.1 |
| Variety | 1 |
| Wind | 1.5 |

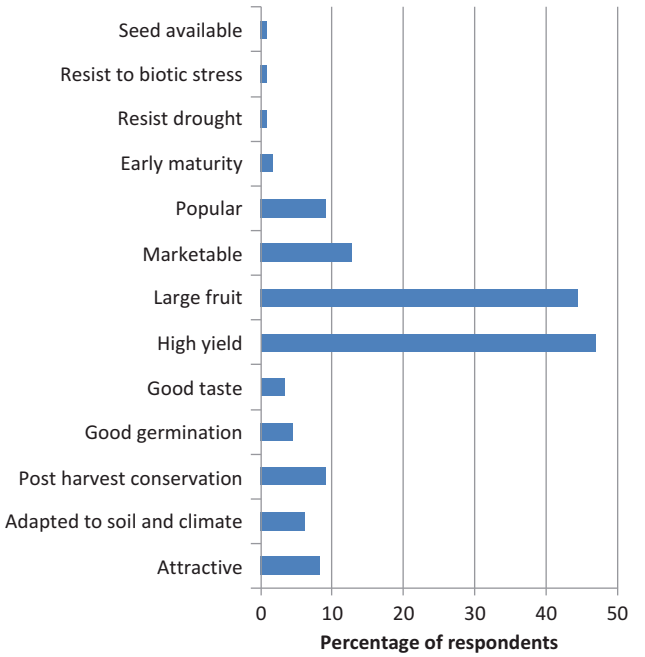


**Figure 4:** Acceptable traits of susceptible vegetable varieties. Precocity is early maturity of the crop.

## Pest Management Practices

Most used synthetic pesticides against fungal diseases and insect pests (Figure 5). Producers recognized that a number of methods exist for control of insect pests and diseases other than chemical pesticides (Table 5). Sixteen percent of farmers know about natural enemies of insect pests. Insects identified by farmers as beneficial natural enemies were ants, bees, black ants, butterflies, crickets, ladybird beetles, praying mantis, snails, spiders, and wasps.

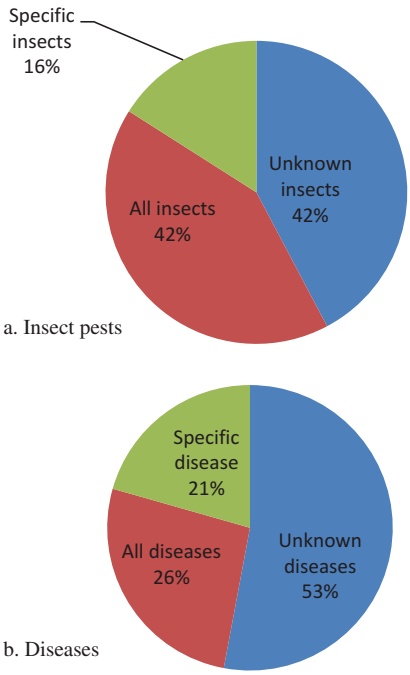


**Figure 5:** Farmer knowledge of control of a) insect pests and b) diseases.

**Table 5:** Percentage of farmers who used methods other than chemical control (pesticides) for pest management.

| Alternative pest management | Percentage |
|---|---|
| Do not know | 74.8 |
| Use resistant varieties | 0.5 |
| Farming systems | 6 |
| Engine oil | 0.5 |
| Integrated pest management | 0.5 |
| Tobacco solution | 4.5 |
| Wood ash | 10.2 |

## Information Needs

Most respondents did not have access to information about integrated pest management, pesticide use and safety, or insect and disease identification (Table 6). The vegetable growers depend on the experience of others for advice on managing pests and diseases (Table 6).

With a high rate of pesticide use, 92% of farmers declared their willingness to adopt measures that would reduce pesticide use. Some measures proposed include use of wood ash, resistant and tolerant varieties, proper field management, and appropriate pesticides application. Other methods included

**Table 6:** Source of vegetable pest management information in Cameroon.

| Source of information | Yes (%) | No (%) |
|---|---|---|
| Other farmers | 73.1 | 26.9 |
| Agro-dealers | 20 | 80 |
| Radio | 5 | 95 |
| Newspapers | 10 | 90 |
| Seed companies | 16 | 84 |
| Extension agents | 38 | 62 |
| TV | 7.1 | 92.9 |
| Other | 11.7 | 88.3 |



good fertilization, use of biopesticides, and crop rotation. If seed of resistant or tolerant varieties were available to farmers, almost all (92%) would adopt their use.

## DISCUSSION

Hovorka (2005) reported that urban agriculture is an important source of food and jobs in Botswana. This was not the case in this study as more farmers were in rural areas, although most inland valleys in cities were locations of vegetable farms. Most vegetables are produced in rural areas and peripheries of cities where resource-poor and less educated farmers are found. This could be the reason for the low level of farmer knowledge of vegetable pests and diseases and management methods. Most farmers were men, as was the case in Botswana (Obopile et al., 2008), where agriculture is not considered an activity for women. However, Ratta (1993) reported that women in some developing countries farm; men manage income-generating activities; and women manage vegetable production. Ratta (1993) further stated that farming is a viable alternative to waged labor for women who lack access to formal employment due to limited education, training, and other opportunities. Less than 50% of farmers completed at least primary school; fewer completed secondary school and level of education impacted awareness and effectiveness of technology information (Elizabeth and Zira, 2009). Socioeconomic characteristics of vegetable farmers in Nigeria indicated that 78% attended through primary school, corroborating our findings that most farmers are less educated. This confirms the conclusion by Ratta (1993) that farming is a viable alternative to waged labor for those who lack formal employment due to limited education.

All producers were small land holders, as was also determined by Elizabeth and Zira (2009). Autissier (1994) indicated that vegetable cultivation is production of annual plants (shrubby or herbaceous) in a delimited agrarian space, generally exploited intensively. The use of small vegetable farms could be a

result of the intensive nature of vegetable production and the high cost of chemical inputs, which increases cost of production. In addition, lack of adequate knowledge of vegetable production and protection from biotic and maybe abiotic constraints could prevent vegetable farm size from increasing. Reduced size of the area enables resource-poor farmers to effectively manage their production.

Pests and diseases are important constraints to vegetable production in the tropics. Insect pests are more important in the dry season; diseases are more problematic in the rainy season. Humidity, soil-borne diseases, and climate change are reasons for pest and disease pressure (Mossler and Dunn, 2009). Despite the influence of moist, warm climates on vegetable pest severity, most farmers grow vegetables in all seasons; in the rainy season water is available and high income is generated from vegetable production.

Blight, mildew, and wilt were the most serious pests. Similarly, the causal agents for blight and mildew (Fontem and Schippers, 2004) and a range of viruses (Letts et al., 2009), misdirection of federal funds, equipment, and effort affect disease pressure. Aphids were the most recurrent insect pest on vegetable crops (Kekeunou et al., 2006; Praveen and Dhandapani, 2002). Most insect pests are vectors of disease organisms (Meyer, 2003). Viruses were identified by farmers among diseases in addition to blight and bacteria. Their ability to identify and talk about insect pests and diseases could indicate how economically important they are to farmers, since their identification knowledge is low.

Many farmers could identify factors that support pests and diseases. Landston and Eaker (2009) reported that rain, heavy dews, warm temperatures, and dry climates (mostly for insects, whose infestation is affected by rain) are principal conditions favoring pest establishment. Although cultural practices are recommended for pest management, the practices were not accepted over chemical pesticides to increase production (Holmer et al., 2001). Although all farmers used chemical pesticides, as also indicated by Obopile et al. (2007), they did not have a good knowledge of pesticide handling. Most commonly used insecticides were dimethoate, deltamethrin, and cypermethrine, and the most commonly used fungicides were maneb, metalaxyl, manizan, and mancozeb (Matthews et al., 2003). Here, and in the work of Elizabeth and Zira (2009), it was reported that most vegetable farmers received extension information from neighbors and had little or no contact with government departments. They also reported that almost all respondents were aware of extension services, and an equal percentage recognized the usefulness of extension services. However, most were never visited by the extension service, which likely resulted in farmers' inability to identify pests and diseases of vegetables, poor pest management skills, and lack of good knowledge of the use of chemical pesticides.

Vegetable production is changing from women to men. Agriculture is considered a job for the underprivileged and school dropouts. Vegetable production is a year-round activity in the tropics. Pests and diseases are important constraints to vegetable production. Knowledge of crop diseases constitutes a major obstacle in vegetable production systems. To increase availability of vegetables, their production needs to be intensified in urban areas, especially in developing countries (Hovorka, 2005). Vegetable breeding for resistance to major pests and diseases should consider consumer preference in addition to yield. Introduction of training programs for farmers on identification and management of pests and safe use of pesticides is necessary. This will improve farmer knowledge of diseases and insect pests and improve management practices, especially with the high illiteracy level among farmers and the aging farming population.



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