Crop Protection 56 (2014) 50–54

Contents lists available at ScienceDirect

Crop Protection

journal homepage: www.elsevier.com/locate/cropro

Short communication

Crop losses and the economic impact of insect pests on Brazilian agriculture

C.M. Oliveira [a,*], A.M. Auad [b], S.M. Mendes [c], M.R. Frizzas [d]

[a] Embrapa Cerrados, Rod. BR 020, Km 18, Caixa Postal 08223, Planaltina/DF 73 310-970, Brazil
[b] Embrapa Gado de Leite, Rua Eugênio do Nascimento, 610, Dom Bosco, Juiz de Fora/MG 36 038-330, Brazil
[c] Embrapa Milho e Sorgo, Rod. MG 424, Km 45, C. P. 285, Sete Lagoas/MG 35 701-970, Brazil
[d] Universidade de Brasília (UnB), Campus Universitário Darcy Ribeiro, Instituto de Ciências Biológicas, Departamento de Zoologia, C. P. 04661, Brasília/DF 70 910-900, Brazil

ARTICLE INFO

Article history:
Received 12 July 2013
Received in revised form
25 October 2013
Accepted 25 October 2013

Keywords:
Insecta
Social and environmental cost
Brazilian agribusiness
Estimated losses
Damages
Brazil

ABSTRACT

Among the various sectors of the Brazilian economy, agriculture plays a prominent role, generating jobs and income for the country. However, the agricultural sector faces systematic annual losses due to pests and diseases. The damage caused by insect pests is one of the primary factors leading to the reduced production of major crops. The study presented here estimates the production losses of major crops caused by insects and the economic impact related to the direct damage caused by insects, to the purchase of insecticides, and to medical treatment for humans poisoned by insecticides. The results indicate that insect pests cause an average annual loss of 7.7% in production in Brazil, which is a reduction of approximately 25 million tons of food, fiber, and biofuels. The total annual economic losses reach approximately US$ 17.7 billion. These results are important for government policies in the agricultural sector, as well as indicate the need for updated data regarding the losses caused by insects in Brazil and the need for systematic monitoring of these losses.

1. Introduction

Brazilian agriculture is a primary sector that generates income for the country (Baer, 2002; Barros et al., 2009; Morán, 1993); agriculture accounted for 4.45% of the gross domestic product (GDP) and reached US$ 100.1 billion in 2012 (IBGE, 2013a). Agricultural commodities have been the main focus of Brazilian production and exports. Globally, Brazil is currently one of the leading manufacturers and exporters of food, fibers, meat and energy, and it is one of the largest producers of coffee, corn, soybeans, sugarcane (sugar and ethanol), oil plants, oranges (fresh fruit and juice), grapes, and bovine, swine, and poultry meat (USDA, 2013).

Insect pests are the major competitors with humans for resources generated by agriculture, and are favored by monocultures in extensive areas and the intensive use of fertilizers (Oerke and Dehne, 2004). The damage caused by these organisms is one of the most important factors in the reduced productivity of any crop plant species (Cramer, 1967; Metcalf, 1996; Pimentel, 1976). Losses can occur in the field (pre-harvest) and during storage (post-harvest) (Oerke, 2006).

Accurate estimates of agricultural losses caused by insects are difficult to obtain because the damage caused by these organisms depends on a number of factors related to environmental conditions, the plant species being cultivated, the socioeconomic conditions of farmers, and the level of technology used. By contrast, few governments have solid programs to monitor and systematically evaluate the losses in agricultural activities that are caused by pests, including insect pests (Yudelman et al., 1998). In Brazil, data on agricultural losses caused by insects are extremely scarce and scattered in the scientific literature.

In addition to the economic losses caused by the direct action of insect pests that damage crops, the measures taken to control these organisms can also cause indirect economic losses related to the purchase and application of insecticides, to expenses related to medical treatment for people poisoned by insecticides, and to damage caused by environmental contamination.

The objective of this study was to estimate the production losses and economic losses caused by insect pests affecting major crops grown in Brazil, including losses related to direct damage caused by pests, to the purchase of insecticides, and to medical expenses for

* Corresponding author. Tel.: +55 61 3388 9861.
E-mail address: charles.oliveira@embrapa.br (C.M. Oliveira).

0261-2194/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.cropro.2013.10.022

humans poisoned by the insecticides used to control these organisms.

2. Material and methods

The estimated economic losses in the production of plants cultivated in Brazil were based on the percentage of damage caused by insects (pre-harvest losses) proposed by Goellner (1993) and Bento (1999), which is based on normal crop conditions; therefore, this measure is related to crop losses caused by insects even after control measures have been adopted (*sensu* Oerke et al., 1994). Economic losses (Table 1) were estimated for each crop by multiplying the estimated loss in production (*sensu* Walker, 1983) caused by insect pests and the mean price paid to the producer per kilogram or liter of each product. Economic losses per unit area (US$/ha) (Table 1) were estimated by dividing the economic losses caused by insect pests obtained for each crop by planted area. The mean percentage of losses in production for all crops was obtained by multiplying the total loss in production by 100 divided by the total yield of crops. The data regarding the production of each crop were obtained from the National Supply Company (CONAB) and the Brazilian Institute of Geography and Statistics (IBGE) (CONAB, 2012, 2013a, 2013b; IBGE, 2013b, 2013c), and average prices for each product were obtained from the Ministry of Agriculture, Livestock

Table 1
Quantification of the crop losses and economic impact of insect pests on agricultural crops grown in Brazil and consumption and sale value of insecticides by crop.

	Losses [a]	Production (1000 t)[b]	Economic loss (million US$)[c]	Economic loss (US$/ha)	Production loss (1000 t)	Insecticides (1000 t)[d]	Insecticides sales (1000 US$)[d]
Crops							
Sugarcane (sugar)	10	37664.2	2528.33	541	4184.9	4758[i]	262,167[i]
Sugarcane (ethanol)[e]	10	23624.1	2081.42		2624.9		
Corn	7	76068.2	1945.75	126	5725.6	11,386	242,699
Soybeans	5	82063.5	1518.63	55	4319.1	83,667	1,322,191
Tobacco	31	851.9	1112.79	2730	382.7	148	10,228
Arabica coffee	12	2300.6	1018.76	441	313.7	8180[j]	130,113[j]
Beans	7	3283.8	581.75	182	247.2	1556	39,612
Rice	10	12050.1	543.31	225	1338.9	1557	32,873
Cotton	10	1399.8	409.14	592	155.5	32,760[k]	589,947[k]
Robusta coffee	12	748.9	271.87	682	102.1		
Cotton seed	10	2249.1	163.56		249.9		
Peanut	43	320.8	161.44	1680	242.0	233	7933
Cassava	2	24455.7	116.21	66	499.1	*	*
Wheat	5	4300.4	106.83	56	226.3	1162)[l]	41,072[l]
Sorghum	5	2246.6	23.81	30	118.2	*	*
Barley	7	260.8	7.17	71	19.6		
Fruits							
Oranges	10	18408.6	520.55	642	2045.4	9198	81,497
Bananas	10	7304.0	383.05	768	811.6	202	1260
Apples	6	1375.5	164.66	4281	87.8	1870	6506
Coconuts[f]	12	1932.5	162.53	628	263.5	*	*
Grapes	4	1483.0	80.49	1004	61.8	155	3796
Cacao	10	243.8	67.00	99	27.1	*	*
Cashew nuts	15	276.4	47.27	64	48.8	*	*
Passion fruit	2	920.2	35.45	573	18.8	*	*
Tangerines	6	1122.7	34.73	652	71.7	*	*
Pineapples[f]	3	1580.8	30.77	506	48.9	*	*
Papayas	4	1871.3	29.44	820	78.0	*	*
Limes	6	1020.3	26.23	552	65.1	*	*
Mangoes	3	1188.9	18.28	239	36.8	*	*
Melons	2	478.4	9.09	461	9.8	67	2983
Guavas	5	316.4	6.50	407	16.7	*	*
Peaches	5	220.7	5.48	272	11.6	*	*
Dendê palm nuts	2	1292.7	4.73	43	26.4	*	*
Vegetables							
Tomatoes	7	3862.9	243.37	3807	290.8	1675	49,653
Onions	5	1314.7	47.90	835	69.2	108	2132
Garlic	5	101.0	26.76	2655	5.3	20	387
Potatoes	3	3615.9	26.74	204	111.8	2168	37,903
Other crops							
Rubber[g]	30	221.8	168.72	1242	95.1	*	*
Miscellaneous[h]						3204	59,385
Total			14730.54			164,074	2,924,337

*Data not available.
[a] Percentage of losses caused by insects based on Goellner (1993) and Bento (1999).
[b] Source: CONAB (2012); CONAB (2013a, 2013b) and IBGE (2013b, 2013c).
[c] Based on the average price paid to the farmer per kilogram or liter, source: Anonymous (2012), CEPEA (2013) and IEA (2013).
[d] Source: SINDAG (2013).
[e] Thousand liters.
[f] Million fruits.
[g] Kg of natural rubber.
[h] Total refers to cultivation of flowers; fruit (not present in Table 1), vegetables (not present in Table 1); pasture; species used for reforestation and stored grain.
[i] Total refers to cultivation of sugarcane for production of sugar and alcohol.
[j] Total refers to cultivation of coffee arabica and conilon.
[k] Total refers to cultivation of cotton for lint and seed production.
[l] Total refers to cultivation of wheat, barley, oats and rye.