

Table 1 Commodity weight loss or damage resulting from *Tribolium castaneum* feeding

Commodity	Duration	% Loss	Damage	No. Insect	Source
cassava flour	survey		18.4		Ajay and Rahman 2006 ^a
maize flour	survey		22.1		Ajay and Rahman 2006
millet flour	survey		34.2		Ajay and Rahman 2006
semovita grits	survey		20.5		Ajay and Rahman 2006
sorghum flour	survey		27.6		Ajay and Rahman 2006
wheat flour	survey		40.0		Ajay and Rahman 2006
yam flour	survey		14.2		Ajay and Rahman 2006
maize, 702	30 d	0.8		172	Ali et al. 2016 ^b
maize, 702	60 d	2.8		619	Ali et al. 2016
maize, 702	90 d	5.0		858	Ali et al. 2016
maize, Kermess	30 d	0.6		150	Ali et al. 2016
maize, Kermess	60 d	2.0		582	Ali et al. 2016
maize, Kermess	90 d	4.6		837	Ali et al. 2016
maize, Kobra	30 d	0.3		120	Ali et al. 2016
maize, Kobra	60 d	1.5		516	Ali et al. 2016
maize, Kobra	90 d	4.2		809	Ali et al. 2016
rice, Basmati 515	30 d	2.7		200	Ali et al. 2016
rice, Basmati 515	60 d	4.5		647	Ali et al. 2016
rice, Basmati 515	90 d	6.2		885	Ali et al. 2016
rice, Basmati 86	30 d	2.5		178	Ali et al. 2016
rice, Basmati 86	60 d	3.9		610	Ali et al. 2016
rice, Basmati 86	90 d	5.5		865	Ali et al. 2016
rice, Super Basmati	30 d	2.1		148	Ali et al. 2016
rice, Super Basmati	60 d	3.4		544	Ali et al. 2016
rice, Super Basmati	90 d	5.1		837	Ali et al. 2016
wheat, AARI-11	30 d	3.7		244	Ali et al. 2016
wheat, AARI-11	60 d	5.6		691	Ali et al. 2016
wheat, AARI-11	90 d	8.7		930	Ali et al. 2016
wheat, Millat-11	30 d	3.5		222	Ali et al. 2016
wheat, Millat-11	60 d	5.2		654	Ali et al. 2016
wheat, Millat-11	90 d	8.5		909	Ali et al. 2016
wheat, Punjab-11	30 d	3.2		192	Ali et al. 2016
wheat, Punjab-11	60 d	4.4		588	Ali et al. 2016
wheat, Punjab-11	90 d	6.1		881	Ali et al. 2016
wheat, 12.2% mc	60 d		2.1	72	Daniels 1956 ^c
wheat, 12.2% mc	120 d		6.2	84	Daniels 1956
wheat, 12.2% mc	180 d		8.7	102	Daniels 1956
wheat, 14.2% mc	60 d		3.3	92	Daniels 1956
wheat, 14.2% mc	120 d		8.3	134	Daniels 1956
wheat, 14.2% mc	180 d		10.8	134	Daniels 1956

biscuit	1 gen	2.2	13	Hamed & Khattak1985 ^d
milk, dry	1 gen	1.6	39	Hamed and Khattak 1985
pop rice	1 gen	5.3	213	Hamed and Khattak 1985
gram flour	1 gen	6.8	209	Hamed and Khattak 1985
starch	1 gen	2.5	3	Hamed and Khattak 1985
wheat bran	1 gen	6.5	449	Hamed and Khattak 1985
wheat flour	1 gen	7.4	307	Hamed and Khattak 1985
wheat shorts	1 gen	6.0	277	Hamed and Khattak 1985
wheat bran	45 d	1.0	154	Hassan et al. 2017 ^e
wheat flour	45 d	1.1	457	Hassan et al. 2017
wheat madia	45 d	1.5	163	Hassan et al. 2017
wheat semolina	45 d	2.0	38.8	Hassan et al. 2017
wheat, Aas	25 d	1.4	26	Hassan et al. 2017
wheat, Galaxay	25 d	0.7	24	Hassan et al. 2017
wheat, Meraj	25 d	0.2	27	Hassan et al. 2017
wheat, Sehar	25 d	3.2	23	Hassan et al. 2017
wheat, Shafaq	25 d	2.4	21	Hassan et al. 2017
barley	90 d	2.5	90.1	Javed et al. 2016 ^f
barley	90 d	5.1	97.5	Javed et al. 2016
barley	90 d	2.6	96.8	Javed et al. 2016
apricot	3 m	1.85	10.25	Khattak et al. 1999 ^g
apricot	6 m	2.1	10	Khattak et al. 1999
apricot	9 m	1.5	10	Khattak et al. 1999
apricot	12 m	1.2	10	Khattak et al. 1999
mulberry	3 m	1.86	11.75	Khattak et al. 1999
mulberry	6 m	1.6	10	Khattak et al. 1999
mulberry	9 m	1.61	10	Khattak et al. 1999
mulberry	12 m	1.81	11	Khattak et al. 1999
fig	3 m	1.34	11	Khattak et al. 1999
fig	6 m	2.20	10	Khattak et al. 1999
fig	9 m	0.78	10	Khattak et al. 1999
fig	12 m	1.09	10	Khattak et al. 1999
raisin	3 m	1.04	10	Khattak et al. 1999
raisin	6 m	1.38	10.25	Khattak et al. 1999
raisin	9 m	1.22	10	Khattak et al. 1999
raisin	12 m	1.28	10	Khattak et al. 1999
date	3 m	1.7	10	Khattak et al. 1999
date	6 m	2.5	11.75	Khattak et al. 1999
date	9 m	1.69	10	Khattak et al. 1999
date	12 m	1.28	10	Khattak et al. 1999
walnut	3 m	4.19	24.7	Khattak et al. 1999
walnut	6 m	6.3	33.7	Khattak et al. 1999
walnut	9 m	8.81	52.7	Khattak et al. 1999
walnut	12 m	10.8	79	Khattak et al. 1999
almond	3 m	5.87	29.5	Khattak et al. 1999
almond	6 m	4.5	19	Khattak et al. 1999

almond	9 m	9.09		29.25	Khattak et al. 1999
almond	12 m	9.01		37.75	Khattak et al. 1999
peanut	3 m	1.01		13.5	Khattak et al. 1999
peanut	6 m	4.73		36	Khattak et al. 1999
peanut	9 m	8.25		33.75	Khattak et al. 1999
peanut	12 m	9.34		73.5	Khattak et al. 1999
pinenut	3 m	6.17		27	Khattak et al. 1999
pinenut	6 m	5.20		42.25	Khattak et al. 1999
pinenut	9 m	9.29		64	Khattak et al. 1999
pinenut	12 m	9.91		75.25	Khattak et al. 1999
chickpea	3 m	10.33		35.25	Khattak et al. 1999
chickpea	6 m	7		33.25	Khattak et al. 1999
chickpea	9 m	20.08		101.5	Khattak et al. 1999
chickpea	12 m	28.34		120.75	Khattak et al. 1999
sorghum, F-114, 28°C	90 d	1.5	3.6	100	Majeed et al. 2016 ^h
sorghum, F-114, 32°C	90 d	3.1	7.2	117	Majeed et al. 2016
sorghum, F-114, 35°C	90 d	1.3	3.1	106	Majeed et al. 2016
sorghum, Hegari, 28°C	90 d	0.7	1.7	84	Majeed et al. 2016
sorghum, Hegari, 32°C	90 d	1.2	2.6	77	Majeed et al. 2016
sorghum, Hegari, 35°C	90 d	0.9	1.9	75	Majeed et al. 2016
sorghum, J.S-2002, 28°C	90 d	1	3.3	97	Majeed et al. 2016
sorghum, J.S-2002, 32°C	90 d	2.8	6.1	113	Majeed et al. 2016
sorghum, J.S-2002, 35°C	90 d	1.7	3.6	104	Majeed et al. 2016
sorghum, M.R.-2011, 28°C	90 d	2.1	4.7	118	Majeed et al. 2016
sorghum, M.R.-2011, 32°C	90 d	4.6	10.1	148	Majeed et al. 2016
sorghum, M.R.-2011, 35°C	90 d	2.3	5.1	128	Majeed et al. 2016
sorghum, P.C-1, 28°C	90 d	1.1	3.4	101	Majeed et al. 2016
sorghum, P.C-1, 32°C	90 d	2	6.2	121	Majeed et al. 2016
sorghum, P.C-1, 35°C	90 d	1.6	4.2	108	Majeed et al. 2016
cassava	70 d	14.2		73	Nwana 1993 ⁱ
cocoyam	70 d	13.3		81	Nwana 1993
cowpea	70 d	10.9		102	Nwana 1993
maize	70 d	9.8		98	Nwana 1993
yam	70 d	13.2		76	Nwana 1993
almonds	140 d	14		50	Rajput et al. 2016 ^j
cashew nuts	140 d	15.6		53	Rajput et al. 2016
peanuts	140 d	8		27	Rajput et al. 2016
walnuts	140 d	11.2		44	Rajput et al. 2016
wheat	140 d	18.8		62	Rajput et al. 2016

a Survey of 15 households for quantity of meals purchased, storage period and damage by *T. castaneum*.

b Weight loss caused by 30 uniform size roughly one-week-old larvae and subsequent generations on 200 grams of 80% whole grains and 20% cracked grain at 13.5% moisture content over 3 months.

- c Damage caused by fifty 6- to 15-day-old adults on 20 grams of whole kernel wheat over 60, 120 and 180 days at $26.7 \pm 1^\circ\text{C}$ and 60 ± 2 , 75 ± 2 or $90 \pm 2\%$ relative humidity.
- d Weight loss caused by initial 2 pairs of 10-day old adults and their offspring on 50 grams food during one generation (35-70 days).
- e Weight loss caused by 50 homogeneous age adults and their offspring on 100 grams food over 45 days.
- f Thirty pair of adults were introduced on 100 g barley seed and percentage weight loss calculated after 90 days.
- g Five pair of 9-12 d-old-adults at $28 \pm 2^\circ\text{C}$ and $60 \pm 5\%$ R.H with 12:12 h light:dark cycle on 150 g of commodity for 3 months, on 250 g for 6 months, on 300 g for 9 months and on 400 g for 12 months storage period.
- h Weight loss caused by about 30 adults and their offspring on 100 grams of sorghum kernels for 90 days at 28, 32 or 35°C and $50 \pm 5\%$ relative humidity in dark.
- i Weight loss caused by 5 pairs of 0- to 7-day-old adults feeding during first 7 days and their offspring feeding during the next 63 days on 50 grams of food under laboratory conditions of fluctuating temperature ($26\text{-}31^\circ\text{C}$ day and $21\text{-}26^\circ\text{C}$ night) and relative humidity (65-95%).
- j Weight loss caused by initial 10 pair of *T. castaneum* and their offspring on 50 grams of commodity over 140 days under laboratory conditions from 6th March 2015 to 24th July 2015.