International Standard 6667

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Green coffee — Determination of proportion of insect-damaged beans

Café vert — Détermination de la proportion de fèves endommagées par les insectes

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Foreword

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International Standard ISO 6667 was prepared by Technical Committee ISO/TC 34, *Agricultural food products.*

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Green coffee — Determination of proportion of insect-damaged beans

0 Introduction

The method described in this International Standard is based on experience gained in the inspection of green coffee beans and in the investigation of the most frequent types of damage to the beans and of the insect species responsible for this damage.

Visual examination of the external surface of green coffee beans is the only practical way to identify and separate beans which have been attacked by insects; thus, the method described applies only to external damage caused by insects.

1 Scope and field of application

This International Standard describes the types of damage caused by insects to green coffee beans and specifies a method for the determination of the proportion of insect-damaged beans in a lot of green coffee, together with the statistical use of the result obtained for technical, commercial and arbitration purposes.

The method is applicable to green coffee as defined in ISO 3509.

2 References

ISO 3509, *Coffee and its products — Vocabulary.*

ISO 4072, *Green coffee in bags — Sampling.*

3 Definition

For the purpose of this International Standard, the following definition applies.

insect-damaged bean: A coffee bean damaged externally by insects.

4 Principle

Visual examination of the external surface of green coffee beans to identity those which have been damaged by insects.

Determination of the observed proportion, as a percentage, of insect-damaged beans and, if possible, identification of the species of insect responsible for the damage.

From the proportion of insect-damaged beans thus determined

— estimation of the confidence limits of the true proportion of insect-damaged beans for a given probability

— estimation of the probability that the true proportion of insect-damaged beans will not exceed a given value.

5 Apparatus

5.1 **Magnifying glass** (recommended)

A magnification of X 5 is suitable for inspection of the surface of beans.

5.2 **Sample-holder** (optional)

The use of a sample holder having a given number of cavities, each capable of holding a whole coffee bean, facilitates counting and separation of beans.

6 Sampling

See ISO 4072.

7 Damage caused by insects

NOTE — Photographs are useful as a means of illustrating damage caused by insects and other types of damage visible on the external surface of the bean. Some photographic illustrations are given in annex A.

7.1 Description

A green coffee bean may show a great variety of damage caused by insects, from minor scars on the surface to a considerable number of holes and tunnels. It is usually impossible to distinguish minor damage from damage of mechanical origin and minor breakage.

For the purpose of this International Standard, only major damage is considered, i.e. those beans with clearly visible holes which are characteristic of insect damage and which cannot be mistaken for other damage.

If a bean shows several signs of damage, it is considered as a single damaged bean.

The two insect species which are most frequently responsible for damaged and infested beans are *Hypothenemus (Stephanoderes) hampei* (coffee bean borer) and *Araecerus fasciculatus* (coffee bean weevil).

The damage caused by these insects to the external surface of beans is very specific and usually also indicates internal damage.

7.2 Identification of insects causing the damage

In addition to assessment of the damage, it is sometimes possible, and useful, to identity the species of insect causing the damage. Damage caused by *H. hampei* and *A. fasciculatus* is different in appearance and the type of damage can thus be used to identify the insect responsible.

7.2.1 Damage caused by *H. hampei*

The damage seen on the bean surface is usually from entry and exit holes, as well as internal cavities.

The holes are small (approximately 0,3 to 1,5 mm in diameter), neatly cut and circular.

There is often a blue-green stain around the damaged surface area.

H. hampei only infests coffee beans in the field and not in storage.

7.2.2 Damage caused by *A. fasciculatus*

The visible damage on the bean surface is usually a bored hole, larger than that of *H. hampei* (from 1,0 to 3,0 mm in diameter) and not as neatly cut.

A. fasciculatus can feed on green coffee beans during storage, if conditions are favourable, producing cavities and other external damage.

8 Procedure

8.1 Preparation of the test sample

Carefully mix the laboratory sample (see annex B for a test for homogeneity of laboratory samples).

8.2 Test portion

Take at random at least 100 whole green coffee beans from the test sample. During counting, replace every broken bean selected by a whole bean taken at random from the test sample.

NOTE — Broken beans will cause errors because a damaged bean may be counted twice or pieces of beans may be counted as whole beans in the total. For this reason, in order to avoid any confusion in the results, the broken beans should be eliminated after being counted and it can be assumed that the proportion of insect-damaged beans subsequently determined on whole beans represents the proportion of insect-damaged beans within the laboratory sample.

8.3 Determination

Operating under good lighting conditions, and preferably using the magnifying glass (5.1), examine the entire surface of each bean in the test portion for the different types of holes characterizing insect damage.

In order to distinguish between a stain or surface defect and a cavity caused by insects, check with a pin to ascertain whether there is really a hole; such a test is particularly useful along the groove of the bean. Count only those beans which show significant penetration as insect-damaged beans.

Separate and count the beans which show damage such as that described in 7.2.1 and 7.2.2.

9 Expression of results

The observed proportion of insect damaged beans, expressed as a percentage, is equal to

$$\frac{n}{N} \times 100$$

where

n is the number of insect-damaged beans;

N is the number of beans examined.

10 Statistical interpretation of results

10.1 Estimation of true proportion of insect-damaged beans

10.1.1 General

The estimate of the true proportion of insect-damaged beans in the lot is obtained from the observed proportion of insect-damaged beans calculated as described in clause 9. The reliability of the estimate (calculation of confidence limits), for a 90 % probability, is determined by means of figure 1, from the observed proportion of insect-damaged beans and the number of beans examined.

10.1.2 Use of figure 1

Find on the abscissa the observed proportion, as a percentage, of insect-damaged beans.

From this point, draw a vertical line which bisects both curves corresponding to the number of beans examined (interpolate for test portions comprising a number of beans not shown in figure 1).

The ordinates at these points of intersection (a for the lower curve and b for the upper curve) indicate the confidence limits corresponding to the observed proportion of insect-damaged beans.

It can be stated, with a 90 % probability, that the true proportion of insect-damaged beans within the lot is between a and b. [i.e. $Pr\ (a < p < b) = 0{,}90$, where p is the true proportion of insect-damaged beans.]

10.1.3 Example

Data:

Number of beans examined: 400

Observed proportion of insect-damaged beans: 10 %

From figure 1:

a = 7,5 %

b = 12,5 %

Thus:

Pr (7,5 % < p < 12,5 %) = 0,90

i.e. with a probability of 90 %, the proportion of insect-damaged beans within the lot is between 7,5 and 12,5 %.

10.1.4 Reducing the two-sided confidence interval

If it is wished to reduce the two-sided confidence interval, proceed as follows.

Take a second test portion of at least 200 beans and proceed as described in 8.3 (if the second test portion appears to be different from the first, check the homogeneity of the laboratory sample by the method described in annex B).

Add together the numbers of insect-damaged beans from the first and second test portions and the numbers of beans examined in both test portions.

Calculate the new proportion of insect-damaged beans and proceed as indicated in 10.1.2 to determine the new confidence limits.

10.2 Determination of the probability that the true proportion of insect-damaged beans does not exceed a given value

10.2.1 General

The probability that the true proportion of insect-damaged beans in a lot does not exceed a given value is obtained from the observed proportion of insect-damaged beans in the test portion (see clause 9 and figures 2 to 6).

Figures 2 to 6, which are based on the assumption that the distribution is fundamentally binomial, indicate the probability that the true proportion of insect-damaged beans in a lot does not exceed a predetermined value, once the proportion of insect-damaged beans in a sample of n beans is established.

When testing a lot of coffee, a critical probability (confidence level) should be selected to become one of the factors in the decision process. A probability of 90 % is suggested as being appropriate for the use of this method. However, since the method is a general one, other probabilities may be chosen.

10.2.2 Use of figures 2 to 6

Select the figure corresponding to the predetermined value which should not be exceeded.

Find on the abscissa the number of beans examined. If more than one test portion was examined, take the number of beans examined as the sum for all the test portions.

From this point, draw a vertical line until it intersects the curve corresponding to the observed proportion, as a percentage, of insect-damaged beans (interpolate between the curves for fractional values).

The ordinate corresponding to the point of intersection gives the probability (confidence level) that the true proportion of insect-damaged beans within the lot is lower than a predetermined value, the observed proportion of insect-damaged beans being known.

10.2.3 Interpretation of results

If the probability obtained is equal to or greater than the critical probability established by specifications, agreements, etc., the lot shall be considered as containing less insect-damaged beans than the critical level.

If the probability obtained is less than the critical probability, proceed as follows.

Take a second test portion of at least 200 beans and repeat the operations specified in 8.3 (if the second portion appears to be different from the first, check the homogeneity of the laboratory sample by the method specified in annex B).

Add together the numbers of damaged beans from the first and second test portions and the numbers of beans examined in both test portions.

Calculate the new observed proportion of insect-damaged beans and proceed as specified in 10.2.2.

10.2.4 Examples

Data:	Example 1	Example 2
Number of beans examined	400	350
Observed proportion of insect-damaged beans	9 %	5 %
Selected value	10 %	7,5 %
From:	(refer to figure 4)	(refer to figure 5)
Probability	73 %	97 %

Thus:

a) in the case of example 1, there is a 73 % probability that the true proportion of insect-damaged beans in the lot is less than 10 %;

b) in the case of example 2, there is a 97 % probability that the true proportion of insect-damaged beans is less than 7,5 %.

11 Test report

The test report shall show the method used and the results obtained. It shall also mention any operating details not specified in this international Standard, or regarded as optional, together with details of any incidents likely to have influenced the results.

The test report shall contain all the information necessary for the complete identification of the sample.

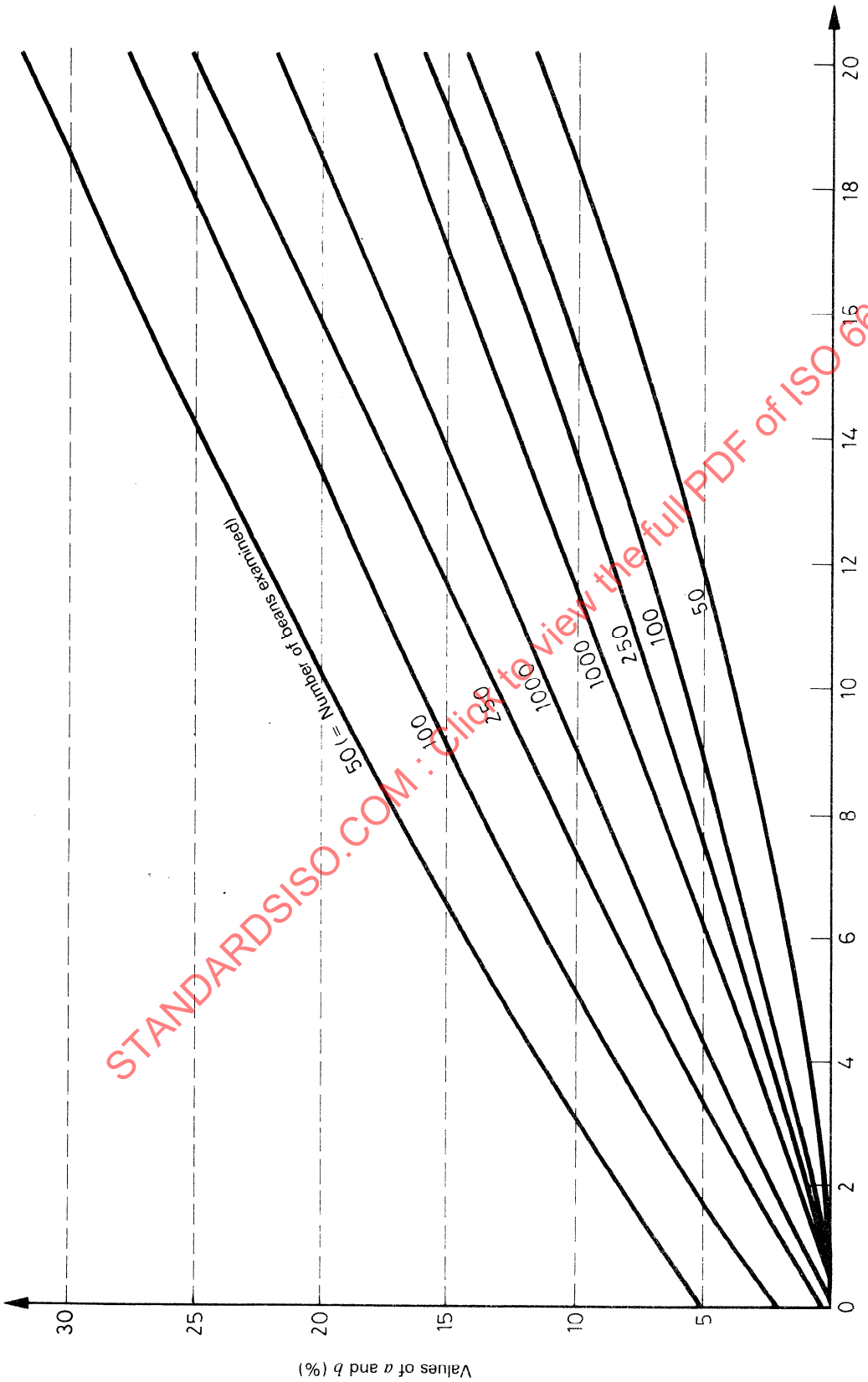


Figure 1 — Estimation of confidence limits [$Pr\ (a < p < b) = 0{,}90$, where p is the true proportion of insect-damaged beans]

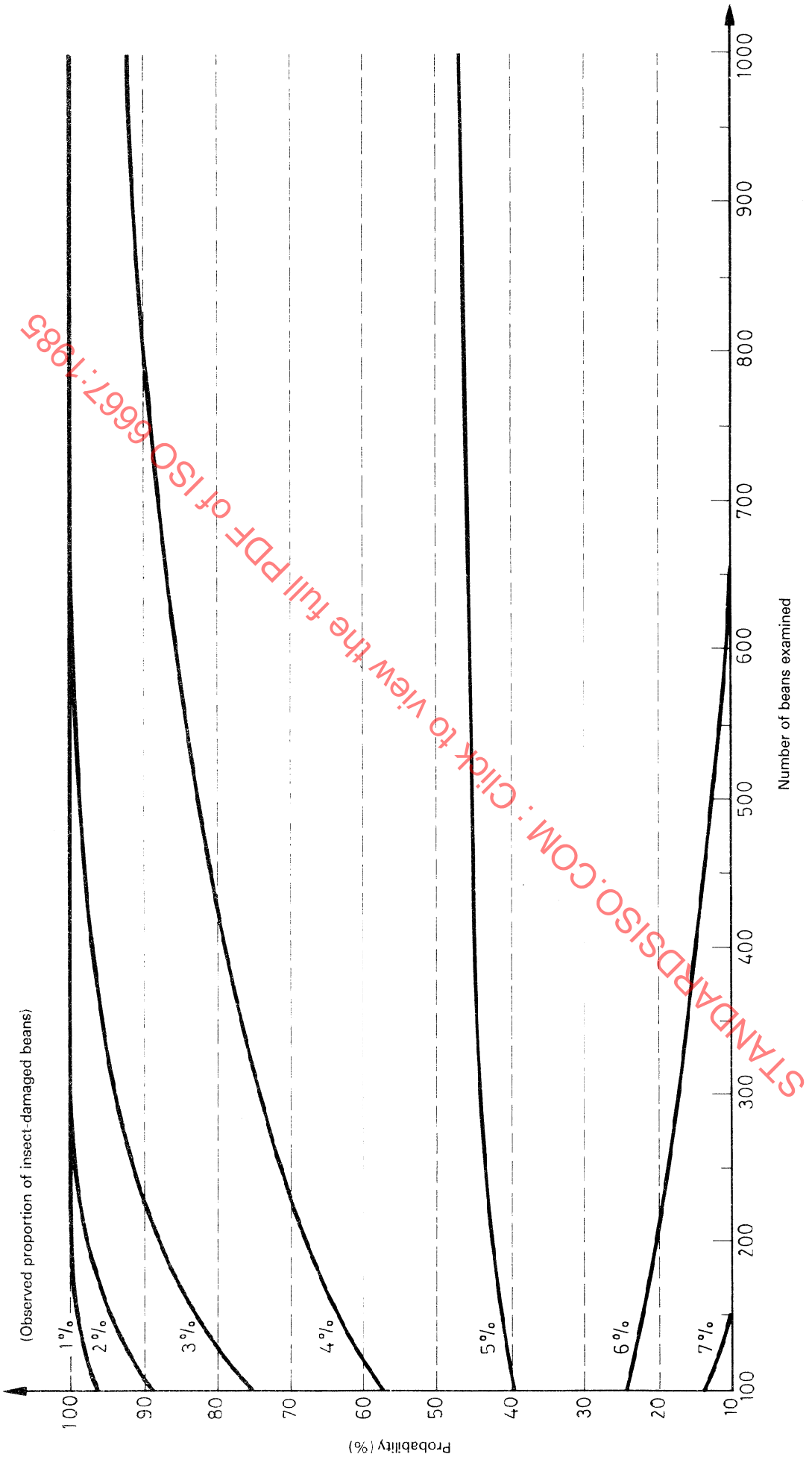


Figure 2 — Probability that the observed proportion of insect-damaged beans is from a lot in which the true proportion does not exceed 5 %

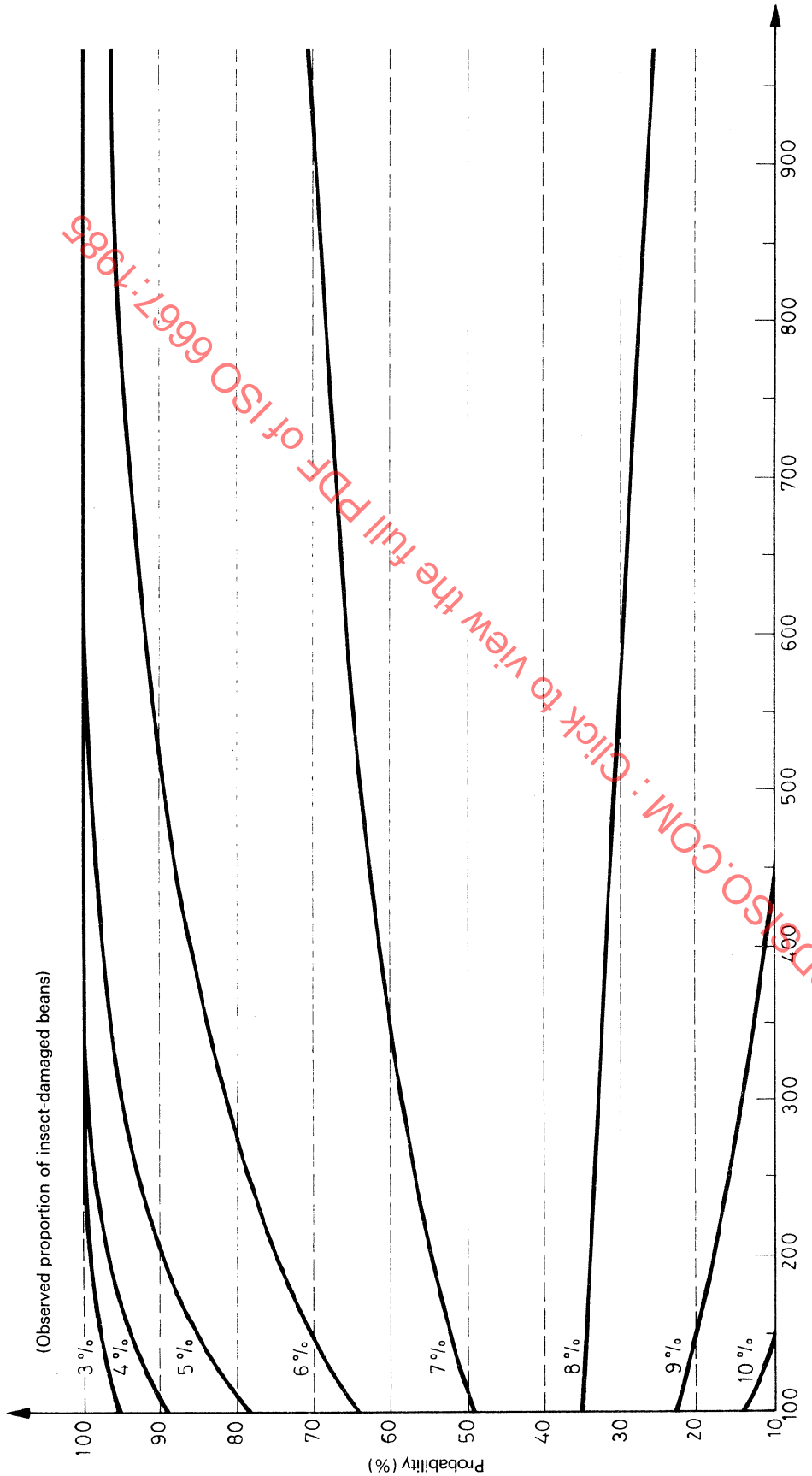


Figure 3 — Probability that the observed proportion of insect-damaged beans is from a lot in which the true proportion does not exceed 7,5 %

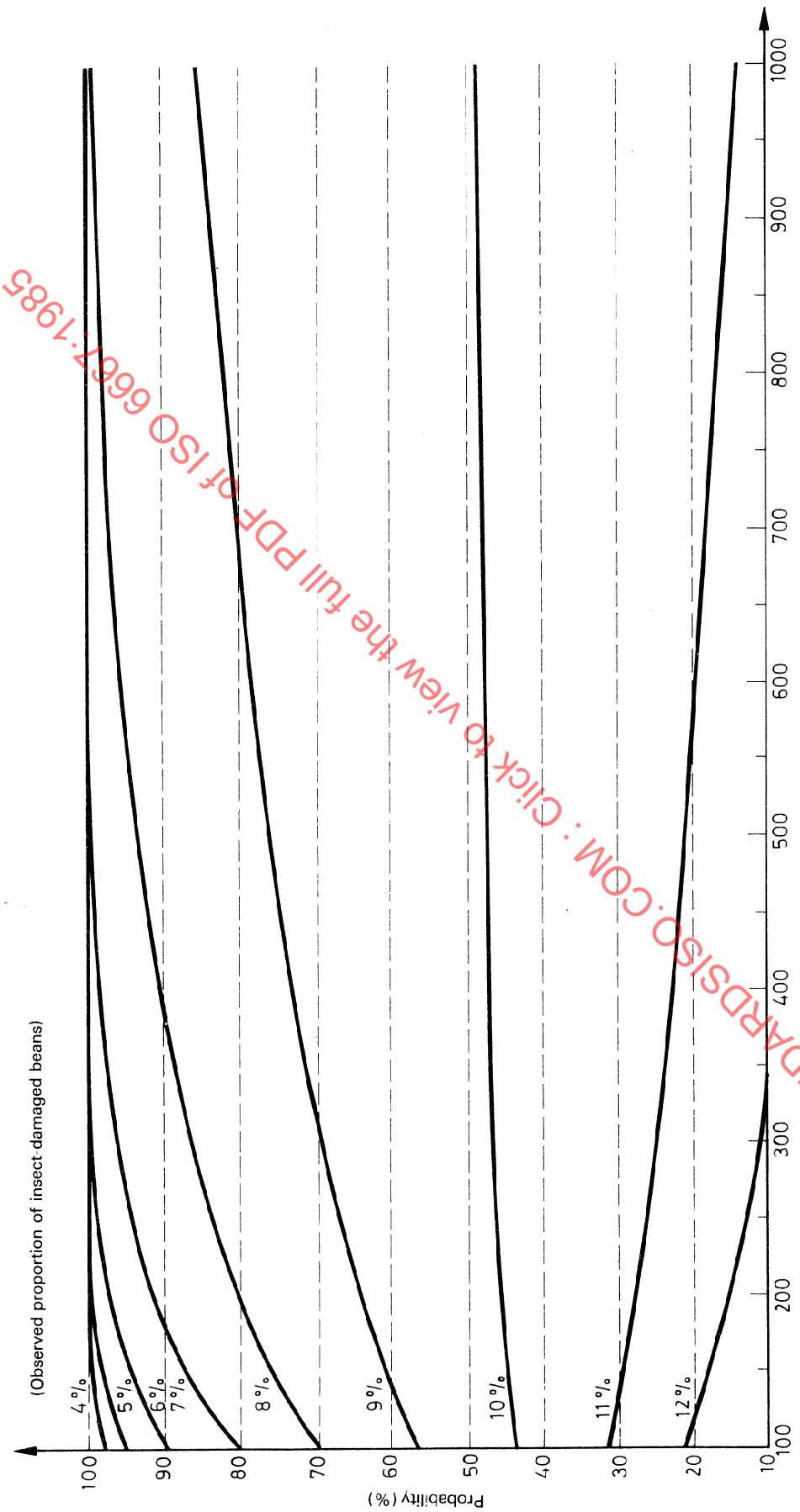


Figure 4 — Probability that the observed proportion of insect-damaged beans is from a lot in which the true proportion does not exceed 10 %

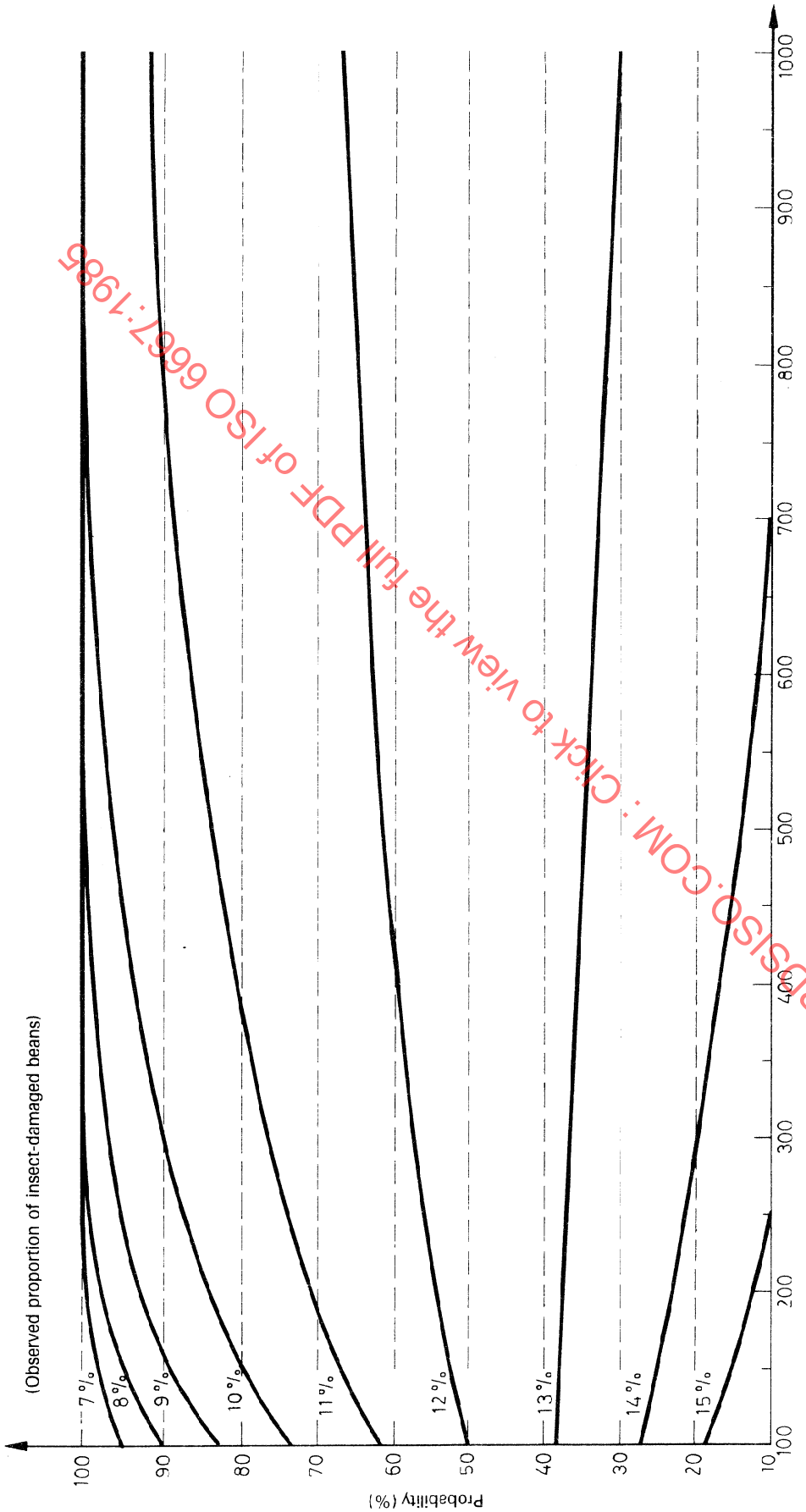


Figure 5 — Probability that the observed proportion of insect-damaged beans is from a lot in which the true proportion does not exceed 12,5 %

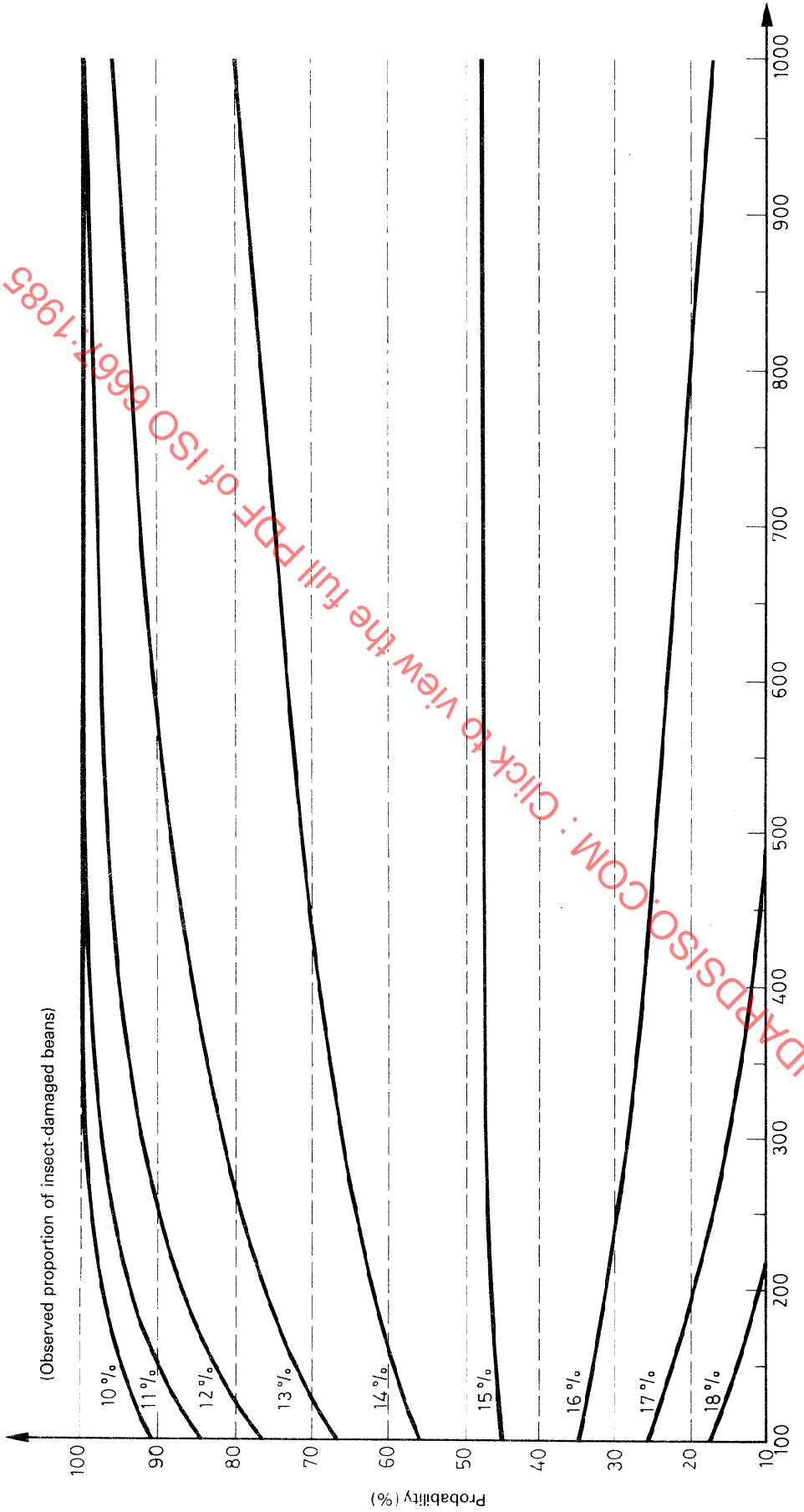
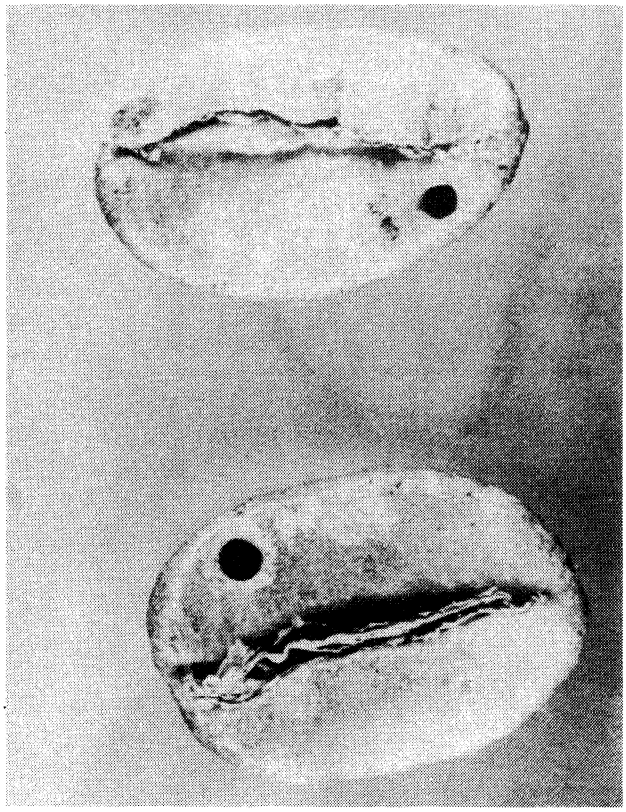


Figure 6 — Probability that the observed proportion of insect-damaged beans is from a lot in which the true proportion does not exceed 15 %

Annex A

Illustrations of damaged beans

A.1 Beans damaged by *H. hampei*



A.2 Beans damaged by *A. fasciculatis*