UDK: 001.8:622.88 +368.025.6:631/.635:368.54:633+581.47

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RISK ASSESSMENT METHODOLOGY IN CROP INSURANCE

PROFESSIONAL WORK

Abstract

Agricultural production is permanently and directly connected with a number of natural factors or forces that are difficult or impossible to predict. Crop production is most common outdoors, where crops are unprotected and exposed to various natural hazards (risks). The intensity of these hazards may be lower or higher, and at times even disastrous. Thus, for insurance companies, crop insurance is one of the riskiest forms of underwriting, whereas for the insured persons it represents one of the most important insurance lines.

Accordingly, in insurance of crops and fruit, loss assessment is crucial because it is expected to ensure a realistic and objective indemnification of insured persons.

Having in mind the abovementioned and numerous novelties introduced to insurance terms and conditions, this paper was produced as a result of the need to inform and meticulously explain to the insureds the methodology and manner in which the assessment of loss to crops and fruit is conducted. It is also intended to help loss adjusters with experiential knowledge acquired in the loss assessment process.

Key words: *Loss assessment method, insurance of crops and fruit, risks in crop insurance.*

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Paper received on: March 13 2019
Paper admitted on: April 2 2019

Introduction

The problem of damage in general, particularly in agriculture, is resolved by various measures taken to counter certain hazards and prevent their occurrence or, when particular hazards have already occurred, minimise the damage or harmful consequences thereof.

As an economic measure used to protect agricultural production against particular natural hazards, insurance also improves agriculture by rendering farmers' entrepreneurial activities more stable and certain. Insurance covers everything destroyed by the occurrence of the insured event and through the indemnification of damage fulfils its described role.[3]

Given that the measures of prevention and repression are not sufficient to fully eliminate economic losses caused by natural hazards, insurance is of crucial practical importance in countering these hazards. By its very purpose, insurance eliminates harmful consequences of certain hazards and enables a smooth and continuous development of the production process. Therefore, insurance business is regarded as the most modern economic method used to protect production, because it ensures the results of work and the assets invested therein.

According to one of the relevant interpretations, insurance is a „relationship established under the contract or the law, where one party, the insurer, assumes the obligation towards the other party, the insured or third party to whose benefit the insurance is concluded (beneficiary), to indemnify the damage (when it comes to property lines) or pay out or keep paying out a particular sum of money (when it comes to personal insurance) upon the occurrence of the unforeseen event (insured event), in consideration of payment of particular amounts of money by the insured, within particular periods".[4] That interpretation includes the most important elements of insurance, from contracting parties and obligations, to indemnity upon the occurrence of the insured event.

Considering the nature of the subject matter and risks involved in insurance of crops and fruit, this type of insurance is characterised by particular issues the resolution of which requires specialised personnel educated in agricultural production. Within the abovementioned tasks, assessment and settlement are among primary obligations. Since successful underwriting i.e. customer satisfaction depends on the correct and well-performed loss assessment or settlement, in this paper we paid special attention to the risk assessment methodology.

[3] Vladimir Njegomir, Boris Marović, Radovan Pejanović, Bogdan Kuzmanović, *Klimatske promene i osiguranje poljoprivrede, Beograd, 2017, pp 275.*

[4] Predrag Šulejić, *Pravo osiguranja,* Novi Sad, 1992, pp. 21.

1. Crops and Fruit Insurance Terms and Conditions

Insurance contract, as an adhesion contract, is a take-it-or-leave-it contract. In insurance contract, one party has pre-defined conditions under which the contract will be concluded, whereas the other party may either accept or refuse such conditions.[5]

1.1. Insured Perils (Risks)

Risk is the most important insurance determinant. As shown by insurance history, insurance would not exist without the existence of risks.[6]

Perils or risks covered by insurance of crop production may be divided into standard and additional. Standard risks are hail, fire and lightning. Additional risks are flood, storm, late spring frost, autumn frost.

The insurer is liable to pay insurance indemnity for the losses caused by damage to, or destruction of the crops and fruit insured against standard risks: hail, fire and lightning.

If additional insurance is agreed under special terms and conditions and provided that the appropriate additional premium is paid, the insurer is also obliged to pay insurance indemnity for the losses arising from additional risks:

1. for all crops and fruit – flood, spring frost and storm;
2. for seed corn – autumn frost.[7]

The General Crop and Fruit Insurance Terms and Conditions issued by various insurance companies stipulate that additional risks may be covered by insurance only if there is insurance against standard risks, except in cases when the plantation is protected with anti-hail net when it is possible to contract only the additional risks. Insurance against additional risks shall be concluded only if insurance of standard risks has previously been concluded, except when the crop, i.e. the seedling is protected against hail by net.[8]

1.1.1. Risk of Hail and Losses Therefrom

Hail is a natural phenomenon or natural disaster which consists of balls or irregular lumps of ice formed in the atmosphere. Hail is produced in clouds called cumulonimbus which have a strong updraft. Hail occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where

[5] Ilija Babić, *Leksikon obligacionog prava*, „Official Gazette of FRY SRJ", Beograd, 1997, pp. 414.
[6] Boris Marović, Dragan Marković, *Osiguranje: katastrofalne štete i klimatske promene,* Beograd, 2016., pp. 41.
[7] „Đenerali osiguranje Srbija" a. d. o, General Terms and Conditions for Insurance of Crops and Fruit, pp. 4.
[8] Dunav Insurance a. d. o, General Terms and Conditions for Insurance of Crops and Fruit, pp. 12.

they freeze into balls of ice i.e. they turn into hail. Hailstone is suspended aloft by air with strong upward motion until its weight overcomes the updraft and falls to the ground. Such hailstones are often not bigger than two millimetres in diameter, but they can grow much larger and make a lot of damage, particularly in agricultural production, and may even pose a threat to people. In the summer of 2001, in the Italian region of Veneto the hailstones the size of an apricot destroyed the crops. In 1998, at the border of the USA and Canada, hail kept falling for nine days leaving more than a million people out of electricity and food. The heaviest hail fell on Bangladesh in 1986; particular iceballs weighed as much as 13.6 kilograms! In that disaster, five people died and about 225 were injured.[9]

Hail is a form of solid precipitation (ice) which by its impact provokes considerable damages and destructions of crops, and may cause damage to other facilities (buildings etc.).[10]

Hailstones are composed of transparent ice or snow particles and may differ in shape resembling small balls, being egg-shaped, or of triangular or irregular shape. Stone size commonly varies between 0.5 and 2 cm and, as already mentioned, it can grow much larger. In the practice of crop insurance i.e. in loss assessment, the size of hailstones is commonly depicted as pea-sized, bean-sized, nut-sized, walnut-sized, egg-sized (of a pigeon or a hen) and the like. In our region, the hail commonly occurs from May to September, but it may also fall beyond this timeframe.

Areas affected by hail are usually limited and are shaped like narrow long strips 6–8 kilometres wide and 20–25 kilometres long. Hail is usually followed by severe weather, thunders, showers, cloudbursts and thunderstorms.

Losses that hail causes to agricultural crops are considerable and may be mechanical (mechanical damage or destruction of tissue or particular parts of plant or the entire plant) and physiological.

These damages are manifested in the form of a loss in yield quantity or properties (quality) of damaged crops or fruit. The resulting damage to agricultural crops can be characterized as total or full, and as partial. The severity of a loss depends on different factors:

- on hail intensity – according to its intensity hail may be: light, dense, small, big, of different shape, dry, followed by rain, storm. The denser, bigger, sharper, drier hail is, the more it is followed by thunderstorms and the longer it lasts, the greater the loss.
- on sensitivity of cultures to hail and on their abilities to regenerate. Agricultural crops are not equally susceptible to hail and thus, one and the same hail can make considerable damage to particular cultures (grape,

[9] *https://sh.wikipedia.org/wiki/Grad_(padavina)*, accessed on 22-01-2013 at 11:10h.

[10] Instructions of the Unique Methodology for the Assessment of Losses from Natural Disasters, *Official Gazette of SFRY* number 27 of 10 April 1987.

fruit, vegetables) whereas when it comes to other products (turnip, potatoes), such damage will be smaller. Particular crops have better ability to recover after hail and thus, the losses will be smaller. The sensitivity of plants to hail is one of the most important elements for determining the price of insurance against this risk.

– on the development stage of the damaged crops. Hail may cause damage to plats in different stages of their development (phenophases of vegetation such as tillering, shooting, flowering and different ripeness stages).
– on the weather before and after the hail. When the distribution of precipitations is favourable, losses can be alleviated or completely avoided.
– on the soil quality: if the soil is of a better quality (black soil, brown forest soil) the plants will more easily recuperate from the damages caused by hail than the plants growing on poorer quality soil (red earth, podsol).[11]
– on soil management. Total size of the loss may be influenced by modern soil management where the plants are provided with optimum conditions for development and growth, and particularly by applying appropriate cropping practices after the damage, with the aim to reduce or prevent further damage.

Hail damages may be divided into two groups: indirect and direct. Indirect damages are losses to the vegetative parts such as stems and leaves, whereas direct damages are those to spikes.[12] Hail inflicts damage on particular parts or the whole plant and thus, vegetative parts (stem, leaf) and generative structures (spike, panicle, flower, anther, pistil) could be affected by the damage. These damages are usually in the form of:

- injuries that may be minor or major and of different shapes. Severity of an injury depends on the strength of hail impact, its density, size, shape, duration and the existence of windstorm. These injuries can be easily spotted 12–14 hours after the hail fall.
- fraction when the stem or any other part is fractured or the connection with the plant was kept. Fraction may occur from other causes and when that is the case, the fraction manifests itself in different directions and not only from the direction of hail fall. Fraction caused by hail has characteristic injuries on the damaged parts of the plant.
- beating, when the beaten down part is completely separated from the plant and has fallen to the ground. In particular plants, beating down of the generative organs causes total loss.
- extraction or impact on grains or fruit of a plant after the fall on the ground. Hail injuries can be spotted more easily when the plants are green than

[11] *https://sr.wikipedia.org/sr-ec/* accessed on 24-01-2019 at 11:40h.
[12] Stevan Jeftić, *Posebno ratarstvo*, Nauka, Beograd, 1992, pp. 110.

when they are in ripening. However, this is not always the case and if there is a dilemma whether a crop is damaged by hail or by other causes, the presence of hail may be identified in the neighbouring green plants of other cultures (corn, fruit), and also on weeds that can be found in plantations or on boundary strips.

1.1.2. Risk of Fire and Lightning and Losses Therefrom

In crop production, fire and lightning strike are also standard insurable perils. The causes of damage by fire are usually agricultural machinery or negligence when burning plant remnants in the surrounding plots. The most affected cultures are wheat, corn and sunflower. In addition to insurance, for the purpose of fire protection in agriculture, notably of grain crops during waxy and full ripeness, harvest, thrashing, transport and storage of grain crops, the Law on Fire Protection[13] stipulates the obligation that all persons participating in harvest activities must take special measures to protect grain crops against fire.

Damages due to lightning strike mostly occur to perennial crop plantations (fruit, grapevine, hop, raspberry, blackberry), by a direct strike of lightning into the tree or indirectly, through the poles and wires struck by lightning. The damages are caused by electric shock, which results in a high temperature that causes plants to wither or be caught in a fire.

1.1.3. Risk of Frost and Losses Therefrom

Frost is a natural phenomenon (hazard) which may occur in a particular period and under particular weather conditions, in a smaller or bigger area. Spring frost means the drop in air temperature below 0 degrees Celsius, which occurs from 1 March to 30 June.[14] Frost hazard is the highest in concave terrains – basins and valleys. This is because at night, the bottom of the basin is the coolest. At the same time, slopes are getting cooled and the cool air, having greater specific gravity, goes down the valley slope to the bottom and the steeper the slope the faster acceleration. In that way, at the bottom of the basin so-called „cold-air pools"are created.[15]

Frosts can be divided into different groups according to their intensity, season and weather conditions.

According to the intensity i.e. the extent of damage caused to plants by frost (except for winter frost), they can be divided into:

[13] Law on Fire Protection, *Official Gazette of RS* nos. 111/2009 and 20/2015, Article 49.

[14] Dunav Insurance Company a. d. o, Beograd, Special Terms and Conditions for Insurance of Crops and Fruit against Spring Frost, Article 2, pp. 3.

[15] Bruno Toscano, *Osiguranje biljne proizvodnje, rizici, uslovi i procena šteta*, Beograd, 2018. pp. 35.

– light frosts, with air temperature from -0.1 to -2° C;
– moderate frosts, with air temperature from -2.1 to -4 ° C;
– heavy frosts, with air temperature below -4° C.

This classification was made because in the spring, flowers and leaves of plants become partly damaged at the temperatures between -2° C and -4° C, and completely frozen at the temperatures below -4° C.[16]

According to the season in which they occur, frosts may be divided into winter, spring, summer and autumn frosts.

In the Serbian region, most hazardous are late spring and strong winter frosts, which cause the biggest damage to the plants. This is particularly true for orchards and vineyards where frost affects the realisation of genus, and sometimes even its survival. These damages are reflected in the fact that the water contained in the intercellular spaces of plants turns into ice crystals, drains the tissue and breaks the cells, that is, provokes the freezing and decaying of certain parts or whole plants.

Agricultural crops are not equally susceptible to frosts. Winter wheat is quite immune to low temperatures, where barley is most susceptible. Plant organs of winter sorts of wheat often have different degree of immunity to frost. The most immune organ is the tillering node which, at that time, is the vital part of the plant.[17] The size of damage to winter crops depends on whether the tillering nodes are damaged or not. Tillering node is the centre of plant's life. When leaves freeze during the winter or the aboveground parts of plant become decayed for any reason, if the tillering node remains alive the plant will regenerate. The death of tillering node means the death of the entire plant. The tillering node is found at the depth of 2-3 cm below ground and its depth depends on cultivation and type of soil, moisture, size of grain, temperature, and light in particular (in a dense system, a shallow tillering formation may occur due to overshadowing and lack of light and in winter this may lead to its denudation, freezing and eventually death of the plant).[18]

Frost may cause particularly big damages to fruit and grapevine. In cold and long winters, particular parts of fruit trees may freeze and even cause the decay of the entire plant. The extent of damage that a late spring frost may cause to different types of fruit depends on a particular fruit phenophase. From the start of vegetation to the setting of fruit, frost may affect buds, blooming flowers and fertilized fruitlets. The temperature of -1° C affects fertilized fruitlets, -2° C affects blooming flowers, whereas the temperatures from -5 to -8° C freezes buds. Fruit buds are the organs most susceptible to frost and may often freeze partly or completely, become brown, dried and fall off, particularly when it comes to apricots, particular types of plums,

[16] Silva Otorepec, *Agrometeorologija,* Naučna knjiga, Beograd, 1991, pp. 55.
[17] Stevan Jeftić, *Posebno ratarstvo,* Nauka, Beograd, 1992., pp. 91.
[18] *https://www.scribd.com/doc/123626288/Ratarstvo-skripta*, accessed on 24-01-2013 at 12:00h.

and peaches. Other sorts of fruit enter the flowering phenophase at a later stage and thus their buds do not freeze so often.[19] Grapevine is susceptible to freezing in autumn, winter and spring. During the autumn, until the leaves start falling, and in the spring, after the buds develop, grapevine is intolerant even to milder frosts (-0.6° C to -1.1° C), whereas when dormant and in the winter, they are able to sustain very heavy frosts (sometimes even up to -30° C). Spring frosts cause the biggest damages to leaves, buds, flowers, grafts and berries that have just developed, causing them to wither, become dark and dried out. If productive shoots die out, young non-productive shoots will grow from the vine because they develop from dormant buds. The easiest way to determine damage or changes to the tissue is by looking at the cross-section of the damaged organ. Sometimes a microscope must be used to accurately determine whether the damage has occurred by frost or by another cause.

Table 1 – Susceptibility of fruit and grapevine to frost

Type	Phase of development		
	Buds	Blooming flowers	Fertilized fruitlets
Apple	-3.8° C	-2.2° C	-1.7° C
Pear	-3.8° C	-2.2° C	-1.1° C
Cherry	-2.2° C	-2.2° C	-1.1° C
Peach	-3.8° C	-2.7° C	-1.1° C
Plum	-3.8° C	-2.2° C	-1.1° C
Apricot	-3.8° C	-2.2° C	-0.6° C
Almond	-4.4° C	-3.3° C	-1.1° C
Walnut	-1.1° C	-1.1° C	-1.1° C
Grapevine	-1.1° C	-0.6° C	-0.6° C

Source: Silva Otorepec, Agrometeorology[20]

In addition to frost intensity, the extent of damage to fruit depends on the duration and frequency of frost. The occurrence of frost in just one night during the flowering of fruit may cause the blossom thinning and if the frost occurs more frequently or is of a strong intensity, it may completely destroy flowers and thus the yield for that year.[21]

1.1.4. Risk of Storm and Losses Therefrom

Wind is horizontal movement or flow of air masses. Wind is classified in different categories according to its direction, speed and strength. Wind direction is usually expressed in terms of its blowing direction (speed in m/s or km/h) and its force is expressed by Beaufort scale.

[19] Milenko Smiljanić, *Priručnik za procenu šteta na usevima i plodovima*, Beograd, 1974, pp. 31.
[20] S. Otorepec, pp. 60.
[21] S. Otorepec, pp. 59.

Beaufort scale for measuring wind force was devised in 1805 by English Rear Admiral and hydrographer Francis Beaufort. The scale has 12 levels and was internationally accepted in 1874.[22]

Table 2 – Beaufort wind scale

Degree (Bf)	Description	Speed			Effects
		m/s	km/h	knot	
0	calm	0	0	0	completely calm, smoke rises vertically
1	light air	0.9	3	2	Direction shown by smoke drift but not by wind vanes.
2	light breeze	2.4	9	5	leaves rustle
3	gentle breeze	4.4	16	7	Leaves and small twigs in constant motion; light flags extended.
4	moderate breeze	6.7	26	9	Raises dust and loose paper; small branches moved.
5	fresh breeze	9.3	34	14	Small trees in leaf begin to sway; crested wavelets form on inland waters.
6	strong breeze	12.3	44	24	whistling heard in telegraph wires; large branches in motion; Large waves begin to form; the white foam crests are more extensive everywhere
7	high wind	15.5	55	30	Whole trees in motion; white foam from breaking waves begins to be blown in streaks along the direction of the wind; spindrift begins to be seen
8	Gale	18.9	68	37	Twigs break off trees; generally impedes progress.
9	Strong gale	22.6	82	44	Brakes of stronger and bigger branches. Slight structural damage (chimney pots and slates removed).
10	Storm, whole gale	26.4	96	52	trees uprooted, considerable structural damage
11	Violent storm	30.5	110	60	widespread damage, roofs removed
12	hurricane	34.8	125	68	devastation

Source: https://sr.wikipedia.org/sr-el/

According to insurance of crops and fruit, damage is compensated only if caused by wind ranked on the Beaufort scale 7-8 and higher.

According to the Special Terms and Conditions for Insurance of Crops and Fruit against Storm issued by Serbian insurers, the storm is defined as movement of air masses, that is the wind measuring 17.2 m/sec. and more.

[22] *https://sr.wikipedia.org/sr-el/*, accessed on 24-01-2013

The occurrence of the risk of storm is evidenced by the reports of the Serbian Hydrometeorological Service of the wind speed, for the area where the insured crops and fruit are situated. The insurer is obliged to obtain such reports. If the Serbian Hydrometeorological Service does not have the data on the wind speed in the area where the damage occurred, the risk of storm to the insured crops and fruit is determined based on the nature of mechanical damages such as twisting, breaking, tearing, pulling and the like.

The insurer is not liable to compensate the damage occurred due to the wind of a lesser force or hot air flows during the summer, such as seeds falling off due to overripeness, interfering with flowering and fertilization, lodging due to high crop density, excessive moisture or plant diseases.[23] Harmful effects of storm on plants are also reflected in the aggravated air and soil dampness which increases the evaporation of water and affects vegetation, causes mechanical damages, lodging, scission, fractions, fruit falling over, branch breaking and even uprooting, and in particular regions buries plants with sand drifts and causes soil erosion. In the flowering period, storm may prevent fertilization and cause flowers and fruitlets to dry out and fall off.

1.1.5. Risk of Flood and Loss Therefrom

Flood is a natural phenomenon which involves unusually high water level in rivers and lakes due to which the water overflows from water body of a river or lake and floods surrounding areas. Causes of floods coming from rivers and lakes are heavy rainfalls or rapid melting of snow and ice, whereas floods coming from seas and big lakes are usually caused by earthquakes, unusually heavy storms, or volcanic eruptions.[24]

In insurance business, the risk of flood is precisely defined in the insurance terms and conditions of the insurers. Flood is understood as elemental, unexpected inundation of the terrain due to outflow of river from its bed, canal and because it broke through a dyke or a dam.[25]

The risk of flood also includes the risk of torrents which is understood as an elemental unexpected flooding of the terrain by water mass formed on slopes due to heavy precipitation and flowing down the streets and roads.

Crops and fruit in moors, lands between rivers and dikes, and unprotected and frequently flooded lands which have no dikes may not be the subject of insurance.[26]

[23] Dunav Insurance a. d. o, Beograd, Special Terms and Conditions for Insurance of Crops and Fruit against Storm, Article 2, pp. 3.

[24] *https://sh.wikipedia.org/wiki/Poplava*, accessed on 28-01- 2019 at 11:02h.

[25] Dunav Insurance a. d. o, Beograd, Special Terms and Conditions for Insurance of Crops and Fruit against Flood, Article 2, pp. 3.

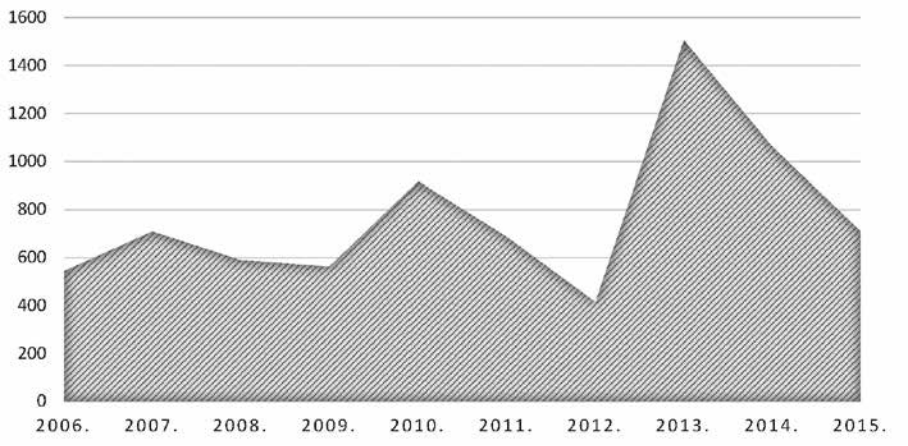
[26] Dunav Insurance a. d. o, Beograd, pp. 3.

Flood losses result from the effects of water which cause landslides and remove and wash away soil, deposit materials to other places and then uproot, clog and suffocate plants. Agricultural crops are highly sensitive to flooding due to excessive moisture which prevents the oxygen to enter the soil and causes the crops to suffocate, become brown, rotten and decayed. Most hazardous are spring floods which cause losses to agricultural crops.

2. Loss Assessment Methodology for Crops and Fruit

After the occurrence of the insured event stipulated in the insurance contract or insurance terms and conditions, the insurer's representatives (loss adjusters) evaluate the loss in cooperation with the insured or his representative. The insurer is obliged to start assessing and evaluating the loss upon receiving the notification of occurrence. The loss is determined and assessed by the agricultural expert selected by the insurer. Insured or his representative may be present at the loss assessment in order to provide information that is necessary for determining the grounds and amount of loss. The assessment may be preliminary (pre-assessment) and final.[27]

Chart 1 – Claims settled on the territory of Serbia in relation to insurance of crops and fruit by years (in 000.000 RSD)



Source: Bruno Toscano, Osiguranje biljne proizvodnje, rizici, uslovi i procena šteta, pp. 613

Chart 1 shows the amounts of settled claims in insurance of crops and fruit by years. Curves of settled claims show considerable deviations relative to the amounts

[27] „Đenerali osiguranje" a. d. o, pp. 7.

i.e. level of claims in the analysed years, which means that they solely depend on the weather conditions that are evidently highly changeable year on year.[28]

The loss adjuster, in addition to his or her expertise (the degree conferred by the Faculty of Agriculture is compulsory), is expected to possess the following characteristics: conscientiousness, objectivity, meticulousness, analytical skills, insightfulness, etc. From starting the fieldwork to the completion of activities, the loss adjuster should take into account all elements that impact a normal and unobstructed work. In this regard, the way of dealing with the insured is of particular importance, whereby in his first contact with the adjuster, the insured needs to have and keep the impression that the adjuster is capable, professional and objective. In assessing the damage, the adjuster should provide the insured with all necessary and appropriate explanations, particularly with professional explanations regarding the findings and conclusions of the assessment, in order to eliminate certain unwanted disagreements or unjustified complaints. The estimated amount of damage should be the result of a careful and detailed inspection of the damaged crops based on professional arguments, which means that any damage should be monitored solely based on actual, realistic and objective condition of the damaged crops.

2.1. Organisation and Time of Assessment

The assessment plan is drawn up so that all damages are assessed in a timely and most rational manner. In doing so, the timing and schedule of the assessment is determined depending on the crops and fruit concerned, as well as the stage of vegetation in which the damaged cultures are. Crops and fruit are a living matter and when damaged in early stages of development, they can get better or worse. If crops and fruit are damaged before ripening or in ripening, the damage cannot be expected to change in any way. However, when the crops are damaged in the early stages of vegetation and the damage is total, the consequences of the loss of yield can best be seen and determined before harvesting or gathering. For this reason, in the insurance of crops and fruit, damaged cultures in early stages of vegetation are subject to preliminary assessment (investigation), whereas before their harvesting or gathering, the loss of yield is determined in the final assessment process.

2.2. Preliminary Fieldwork

Upon his arrival to the place of loss, the loss adjuster should take particular actions to:

– inform all insureds who reported the loss in that area of his arrival to the site and ask them to prepare their insurance policies;

[28] B. Toscano, pp. 613.

– determine moments in connection with the actuation of the insured risk (time of occurrence, direction from which the loss originated, intensity, duration);
– numerous losses require the preparation of activity plan and plan of site visits, organisation of loss assessment and their grouping by cultures that will first be assessed, according to the places where damaged crops and fruit are situated;
– check for any insureds that have not reported the loss until that moment in order to assess their loss, as well;
– inform the policyholder's representatives of group insurance policies that they can participate in the assessment;
– inform the insurance representative or agent who issued the policy so that such person can offer his or her technical help during the field visits;[29]

2.3. Activities after Visiting Damaged Crops and Fruit

Before starting the assessment, the loss adjuster informs himself about the documents concerning the loss and determines whether:
– the damaged crop –fruit is insured;
–the damaged area is reported and insured;
– there is the existence of the loss event covered by insurance;
– the insurance was concluded prior to the loss occurrence.
Then, pays particular attention to:
– development stage of damaged crop cultures;
– severity of damage;
– size of plot;
– principle that preliminary and not final assessment (investigation) is performed in the early stages of plant development, except in cases where the damage is minor and where it can be safely determined that the final percent of damage does not exceed the percent of the sum insured, as well as in the cases of total damage or damage of such severity that the damaged surface needs to be ploughed over or resowed with the same or similar culture.

2.4. Preliminary Assessment (Investigation)

Preliminary assessment requires the determination of all important elements concerning the condition in which the damaged plants are in. For proper

[29] M. Smiljanić, pp. 49.

determination of the amount of damage resulting from the insured risk, its results should be subsequently used in the final assessment. To that extent, the following should be particularly determined:

a) insured culture, place and name of the area – plot;
b) area of the damaged plot, where in the event that the severity of damage is uneven, the plot is divided into parts which were affected by even damage severity.
c) general condition of the damaged crops, their appearance, development phase, height of growth, average number of grown or planted crops per 1 m2 (canopy), the existence of sparse areas, damage from other perils - risks not covered by insurance (droughts, plant diseases and pests), as well as the severity of these damages. In addition, it is of particular importance to compare the damaged with undamaged crops in that region or place;
d) how were agrotechnical measures implemented;
e) what parts of the plants are damaged from the insured risks and how. When particular plants are totally damaged, whereas fruit-bearing organs or fruit of particular plants are completely battered, the percent of totally damaged plants is determined;
f) with regard to crops with more than one gathering or cuts: which gathering or cut was damaged, if cutting or picking was performed before damage and how many times, and how many more are expected until the end of vegetation;
g) what protective measures the insured person should take to recover the crops and prevent further expansion and aggravation of loss;
h) time when the final assessment should be performed.

In order to obtain the average value of the damage, the damaged crops and fruit are inspected in several places of the plot. For some cultures that are sown or planted in rows, the adjuster may previously agree with the insured which rows and which plants will be inspected (for example, in each sixth row, each fifteenth plant) in order to obtain better insight into the average situation and prevent possible complaints of the insured about the place where the sample was selected from.

Since preliminary assessment does not determine the final amount of damage, the resulting damage is expressed just descriptively and not in percents. Certain circumstances and elements concerning the condition the damaged crops are in, and particularly the nature and extent of damage caused by the occurrence of the insured risk, should be defined in the preliminary assessment report in detail and as precisely as possible.

Damaged crops - fruit are grouped according to the nature of the resulting damage so that plants damaged evenly, with equal severity, are found within one group. Completely destroyed plants, battered fruit and battered generative organs are

classified in the group of totally damaged plants. Partly damaged plants are classified into the group of damages that are homogeneous in terms of the type and number of damage sustained. Such damage may manifest in the form of surface damage, deep damage, torn leaf mass, fractured midrib, fractured stem, and battered parts of flowers or fruit. Undamaged plants comprise a separate group. Subsequently, the percentage of plants in each of the abovementioned damage groups is determined, both within the sample and on average, at the level of the entire plot. The obtained results are entered in the preliminary assessment report.[30]

When determining the time limits for damage assessment, it is necessary to take into account that the final damage assessment is made before the crop is harvested or the fruit picked. These time limits are determined depending on the relevant plant culture and depending on the growing area. Since the time of harvesting or picking is not the same everywhere (in the areas with higher altitude the crops are removed later whereas on lower altitudes they are harvested earlier, in certain years a smaller or greater deviation from the usual harvesting or picking time may occur), the final assessment time should be determined together with the insured.

2.5. Final Assessment

In the final assessment, before the determination of the amount of damage, it is firstly determined whether all necessary prerequisites for the insured's right to compensation have been fulfilled according to the concluded insurance contract:

– if the damaged crop or fruit is insured;
– if the plot reported as damaged is actually insured;
– if the loss event covered by insurance has occurred;
– if the insurance was timely concluded prior to the actuation of the insured risk.

In crops, the yield is comprised of grain -seed (grains), stem (hemp), fruit (fruit, grapes), flower (medicinal herbs), leaf (tobacco), rootstocks, cuttings, seedlings.

In the final assessment, the quantitative loss of yield is determined (the yield resulting from the actuation of the insured risk). This loss is determined in relation to the yield that plants would have produced if the insured event had not occurred. In cultures where the loss of quantity and quality is covered by insurance, the assessment determines the loss in both quantity and quality. „The subject matter of insurance shall be the fruit of apples, pears, peaches, apricots and plums in intensive plantations. The Insurer shall pay the insurance indemnity for the damages caused by the loss of yield quantity and quality due to hail. "[31]

[30] Dunav Insurance Company, Uputstvo o načinu rada na poslovima osiguranja useva i plodova, Beograd, 1995, pp. 13.
[31] Dunav Insurance Company a. d. o, Beograd, Special Terms and Conditions for Insurance of Fruit against the Loss in Quantity and Quality, Articles 1 and 2, pp. 3.

When making final assessment, the loss adjuster should determine and enter in the report the following loss assessment elements:

– percent of damage;
– yield that would have been achieved if the loss event had not occurred;
– size of the plot.

2.5.1. Method and Techniques of Assessment – Determining the Damage Percent

The damage or the loss of yield is expressed in percents. For example, if a crop is completely destroyed, the damage is 100%, and if the damage is partial, the amount of damage is expressed in the percent which corresponds to the damage severity, e.g.: 8%, 25%, 50% etc.

Loss assessment or the determination of damage percent may be obtained by applying various methods:

– rule of thumb;
– analytical method;
– measuring.[32]

Assessing the amount of damage by using the rule of thumb is rather subjective which, regardless of the adjuster's experience should not be applied, because damage assessment is an activity requiring professional skills and must be based on objectivity and scientifically recognised methodology.

The method of measuring relates to determining the amount of yield loss by comparing the yield obtained in the damaged plot with the yield in the undamaged plot containing the same crop or fruit. Based on the difference between the first and the second yield, the quantitative loss is calculated and expressed in percentages. For example, the measuring found that the yield on the undamaged and damaged wheat plot was 5,000 kilograms and 4,000 kilograms per hectare, respectively – i.e. it was less than 1,000 kilograms. In such case, the loss i.e. the percent of damage would be calculated as follows:

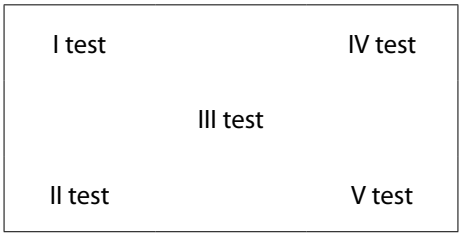
5000: 100 = 1000 : X
X = (1000 X 100) / 5000
X = 20% (percent of damage)

When using this method, it must be taken into account that the comparison of yields is carried out on plots with the same soil fertility, conditions of cultivation, and applied agrotechnical measures. Therefore, this method is very difficult to apply in practice, except in large areas of agricultural enterprises, cooperatives and farms, where damage assessment by this method can be performed by using all necessary technical means and other data.

[32] Dunav Insurance Company, pp. 14.

The analytical method or method of counting consists of individual inspection or counting of a certain number of destroyed, damaged and undamaged plants on several locations of the damaged plots. For example: in five different locations (diagonally) of the damaged plots under wheat the following was determined:

Picture 1 – Graph of the plot with distribution of samples -tests



Source: Author's document based on experiential data obtained in risk assessment of crops and fruit

I Test –100 damaged plants inspected:

10 plants	70%	10 plants	35%
10 plants	50%	10 plants	60%
10 plants	35%	10 plants	40%
10 plants	60%	10 plants	20%
10 plants	undamaged	10 plants	10%
Total		100 plants	3800%

3800 : 100 = 38% (average damage)
Test II –150 plants inspected, the total damage of which is 5290%:
5290/150 = 35%
Test III – 175 plants inspected, the total damage of which is 7050%:
7050/175 = 40%
Test VI – 108 plants inspected, the total damage of which is 5007%:
5007/108 = 46%
Test V – 150 plants inspected, the total damage of which is 6370%:
6370/150 = 42%
On the entire plot, the average damage percent is:

I test	38%
II test	35%
III test	40%
IV test	46%
V test	42%
Total	201%

201/5 = 40 % (damage percent of entire plot)

Test locations - experimental little plots on which damage analysis is performed must not be chosen intentionally, but mechanically, at approximately equal distances across the entire damaged plot. It should be borne in mind that in a larger number of smaller experimental plots more accurate results will be obtained than in a small number of larger plots. Regarding the crops that are sown or planted in rows, the analysis is carried out in certain rows, on a particular number of plants, and on several locations of the damaged plot.[33]

2.5.2. Procedure in the Event of Different Damage to Crops in One Area – Plot

When the crop is heavily damaged on a single plot, this area will be divided into several parts, depending on the area and degree of damage, and in each section, the amount of damage will be separately determined. This method is applied in larger plots or when on its individual parts the amount of yield differs. Such manner of assessment is also applied to the plots where some parts are damaged above and below the deductible (participation of the insured in the damage). The damage to the insured crops and/or fruit of up to 5% of the sum insured shall not be indemnified, unless agreed otherwise.[34] This type of deductible-franchise is used by all insurers of crops and fruit operating in Serbian market. The term "franchise" implies the agreed percentage of damage. If the percent of damage caused by the occurrence of the loss event is lower than the agreed percent of franchise, the insured person is not entitled to insurance indemnity. If the percent of damage caused by the occurrence of the loss event is higher than the agreed percent of franchise, the insured will be fully indemnified.[35]

Example 1: 10 ha plot under wheat is: 5 ha times 10%, 3 ha below 5%, 2 ha undamaged.

Average percent of damage, provided that it is determined for the whole plot, amounts to:

5 ha x 10% = 50
3 ha below 5% = 0
2 ha undamaged = 0
10 ha = 50
50 / 10 = 5% (average damage)

Example 2: the plot of 10 ha under wheat is damaged as follows: 1 ha times 10%, 5 ha times 6%, 4 ha undamaged.

[33] Milenko Smiljanić, *Priručnik za procenu šteta na usevima i plodovima,* Beograd, 1974, pp. 55.
[34] Dunav Insurance Company a. d. o, Beograd, Crop and Fruit Insurance General Terms and Conditions, Article 24, paragraph 5, pp. 18.
[35] „Đenerali osiguranje" a. d. o, pp. 8.

Average percent of damage, provided that it is determined for the whole plot, amounts to:

1 ha x 10% = 10
5 ha x 6% = 30
4 ha undamaged = 0
10 ha = 40
40 / 10 = 4% (average damage)

In examples 1 and 2, some parts of the plot are damaged by the percentage above and below the franchise, and some parts are undamaged. If the damage were determined for the entire plot based on average which is within the scope of franchise, the insured would not receive indemnity, despite being entitled to indemnification for those parts of the plot where the damage percent is six or more. Thus, in such and similar situations, the damage should be determined and expressed in the separate report, by individual parts of the lot.

If the loss percentage on particular parts of the plot is determined to 85% or more, the procedure will be performed in the abovementioned manner. According to the insurance terms and conditions, the areas with such damage are specially treated in loss calculation, more precisely, the costs of unperformed labour is deducted from the loss amount (harvest, picking). The indemnity will be decreased by the production costs that will not be incurred until the completion of harvest or picking, namely, for agriculture by minimum 10% and for vegetable and fruit plants by minimum 20%, taking into consideration the necessary expenses for the removal of plant residue.[36]

2.5.3. Procedure in the Events of Multiple Damages to Crops from the Same Risk or Different Risks Covered by Insurance, in One Area – Plot

When during the vegetation or insurance period the crop is damaged several times by the same risk or several different risks covered by insurance contract, the final assessment will determine the total amount of damage according to the condition in which the crop is in after the last damage.

2.5.4. Determining the Amount of Yield

In loss assessment, the adjuster establishes the yield the damaged crop would have had if the insured risk had not occurred. This is highly important because insurance indemnity is determined:

1. up to the sum insured – if the value of yield equals or exceeds the sum insured;

[36] Dunav Insurance a. d. o, pp. 18.

2. up to the actual yield value – if such value is lower than the sum insured.

The value of the insured crops or fruit is calculated by deducting the yield (reduced due to the damage caused by the occurrence of the insured risks) from the determined yield (which would have been achieved if the damage had not occurred); the yield so obtained is calculated at market or guaranteed prices. For the agreed production, the yield is calculated at the prices agreed with the production organizer.[37]

For example, for cereal grains, the yield is determined based on the plant canopies, number of grains, and weight of 1.000 grains.

Plant canopy is determined by counting the damaged plot in several locations at the surface of 1 m^2, the results obtained are summarized, and the total sum is divided by the number of tests.

The number of grains is determined by taking them for inspection from particular number of spikes at several test locations and by counting the grains in each spike.

400 spikes/m^2 X 25 grains/spike = 10.000 grains/ m^2

Average weight of 1.000 grains is 40 grams.

In this example, the yield per m^2 is 400 grams, which means that the yield is 4.000 kg/ha.

For fruit, the yield is assessed in relation to a number of trees against the total number of fruit on a tree and the number of minimally developed fruit in 1 kg. The average weight per one tree is calculated from the summed up weights of assessed samples which, when multiplied by the number of trees on one hectare, produces the yield per one hectare.

Table 3 – Number of fruit trees per hectare in different planting density

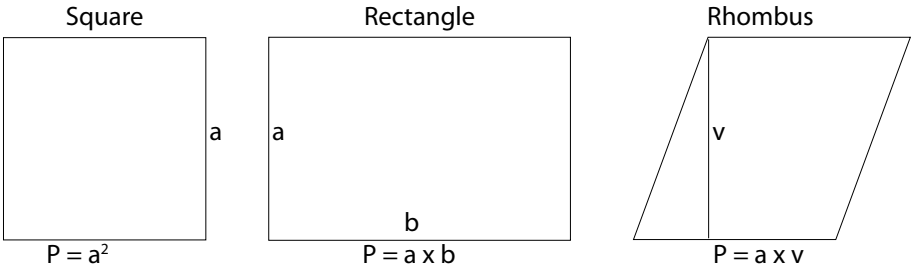
Inter-row distance	Row spacing									
	1	1,5	3	4	5	6	7	8	10	11
2,5	4000	2667	1333	1000	800	667	571	500	400	333
3	3333	2222	1111	833	667	556	476	417	333	278
4	2500	1667	833	625	500	417	357	312	250	208
5	2000	1333	667	500	400	333	286	250	200	167
6	1667	1111	556	417	333	278	238	208	167	139
7	1429	952	476	357	286	238	204	179	143	119
8	1250	833	417	312	250	208	179	156	125	104
10	1000	667	333	250	200	167	143	125	100	83
12	833	556	278	208	167	139	119	104	83	69

Source: https://sadnja.com/vocarstvo

[37] Dunav Insurance a. d. o, pp. 17.

2.5.5. Determining the Area

In assessing the damage, in addition to determining the yield amount and percent of damage, it is equally important to determine the area under the insured or damaged crop, since this element is one of the main factors for determining the total amount of damage. When determining the area size, it is necessary to compare the data stated in the insurance contract with the actual situation in the field. In that case, if necessary, the adjuster will also measure the land. When the area has a geometric shape or is close to having a geometric shape, the area size is determined by applying the corresponding formulas:



Conclusion

The impact of nature and natural forces is permanent but not always equally manifested. By using engineering and agricultural engineering measures people seek to fight and prevent perils and reduce their harmful effects when the risk occurs. In improvement and protection of crop production, insurance industry also plays its role. Upon the occurrence of the insured event, loss indemnity will cover everything destroyed or damaged and afford considerable financial protection to agricultural production.

Loss assessment can be highlighted as the most important insurance component for creating customer loyalty. It ensures a realistic and proper indemnification of insureds. Since a proper and valid loss assessment largely influences customers' decision to buy insurance policies, loss adjuster has a particularly prominent role in insurance business. The assessment process is a particularly complex, professional and responsible task, and its successful and proper performance requires thorough knowledge of crop production, natural hazards, risks, and losses inherent to crops. The adjuster also has to make sure to possess the knowledge of technical bases of insurance to be able to take an appropriate approach to the interpretation and application of insurance terms and conditions under which the insurance contract was concluded.

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