EFFECT OF SEED DRYING ON THE QUALITY OF GERMINATION OF CHILLI (*Capsicum annum* L.)[U1]

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Abstract: *Red peppr is a type of chili that is needed by the community, especially for cooking ingredients and the food sources in Indonesia. There is a need to improve the quantity and quality of domestic red pepper production. In this case, seeds processing be one of factors that can affect the quality of red pepper production, one of them is drying. Drying is a method to reduce the seed moisture content which aims to decrease the respiration rate and the metabolic rate of the seed, so that the seed can be maintained for a longer period of time. The obyectives of experiment were the effect of drying on the germination of Chilli red pepper (Capsicum annum L.). The experiment was conducted at -field laboratory Faculty of Agriculture. The experimental design used was faclorial experiment 2 x 2 aruanged in Complelely Randomized Design (CRD) with replications four times. The first factor-was, drying (D) narnely: room drying (dl) and sun drying (d2). The second factor was drying period (P) namely: I days (pl) and 7 days (p2). The result showed lhat the drying and drying period was afected significanls on the germination.*
Keywords: *seed, drying, germinatiory, red pepper*

INTRODUCTION

The most basic thing in Red Pepper Chilli production is the use of seeds. To produce good red pepper chilli, the seeds used must be superior and of high quality. According to Sumarno (1994) the requirements of high quality seeds are: (1) pure and known varieties; (2) have high germination (>80%); (3) have good vigor, which can grow quickly and synchronously, and the sprouts are healthy; (4) clean and not mixed with grass seeds, seed debris or seeds of other plants; (5) healthy, not infected with fungi that can cause the sprouts to rot; (6) pithy, not wrinkled, no traces of insect bites, and have been completely dried out.

Most of the farmers have realised that the use of good quality seeds will enhance the quality and quantity of their farming products. Often times, farmers experience significant losses in both cost and valuable time due to the use of poor and inferior seeds. In many areas when seeds are harvested they are often insufficiently dry for storage until the following planting season. In many areas when seeds are harvested they are often insufficiently dry for storage until the following planting season. It can be briefly stated that the problems in the field of seed technology mostly lead to aspects in the field of seed production, processing, storage and testing (Tresniawati et al 2014). The seeds themselves should represent the performance of several factors such as varietal correctness, "germination percentage, grain percentage, vigour, freedom from pests and diseases and other contaminants". Seed failure to achieve one or more of these characteristics may indicate poor quality seed. Traditionally, seed selection is done at the time of harvest, the fruit as prospective seeds taken for storage and later planting again must be obtained and derived directly from the selected plant. Seeds must be harvested on time to ensure high seed vigour, and are then dried (Yuniarti et al 2018).

Three major factors affecting the germination of seed during mechanical drying are the initial moisture content of the seed, the temperature employed, and the length of time the seeds are exposed to the heated air. The seed drying process is carried out in various forms and ways, depending on the type of seed, length of storage, environmental conditions and local customs. The most commonly used drying methods are sun drying and air drying. How to dry the seeds so that they are not damaged is a matter of technology.

A seed crop is often harvested when the seed moisture content is higher generally 14% or less is considered satisfactory for short term storage (Jakel and Markus, 2018). Seeds are also susceptible to drying injury in several ways, they are sensitive to high temperatures, depending on the species (Agha et al, 2017; Bajusa et al 2019). Seeds may also be injured by drying too rapidly or by over drying. To obtain a good dryer performance seed moisture content, depth of seed in bin, air temperature and air volume must be controlled Krestini et al, 2013). A farmer wants to dry seed quickly, but high temperature may cause damage seed viability and vigour. The effect of high temperature is most damaging when the moisture content of the seed is high. The goal of the entry is to point out the impact of drying temperature on the seed quality of the food industry when it comes to micro-damage. For this reason, this study was conducted with the aim of determining the effect of drying system and duration on seed survival per cent and seedling quality.

MATERIALS AND METHODS[U2]

A. Location and Time of Research

The experiment as well as the seed collection process was conducted at the Basic Science Laboratory and Field Laboratory of the Faculty of Agriculture, University of 17 Agustus 1945 Samarinda for 12 weeks.

B. Materials

The materials (seed) used in this study were red pepper chilli seeds (*Capsicum annum* L.). The seeds were extracted from the fruits seeds are obtained by traditional methods, from healthy chilli fruits with excellent appearance (free of pests, fresh, large and evenly red in colour). All seeds were then put in a container filled with water. Those that floated on the surface of the water, representing non-viable seeds were discarded.

C. Methods

Completely Randomized Design (CRD) An Experiment Factorial Design Pattern 2x2 method was used in this research and replicated five times. The first factor is the drying system (D) consisting of 2 levels, namely: air-dried in the room (d1) and sun-dried (d2). The second factor is the duration of drying (P) consisting of 2 levels, namely: dried for 1 day (p1) and dried for 7 days (p2).

D. Data Analisys

Data collected included:(1) Percentage of germinated seeds, 30 days (4 weeks) after sowing (based on the definition of germination according to the Seed Certification and Supervision Centre; the term "germination" means the percentage of seeds capable of producing normal seedlings under ordinarily favorable conditions (not including seeds which produce week, malformed, or obviously abnormal sprouts)); and (2) Height of 30-day-old seedlings (4 weeks). To determine the effect of drying and duration of drying and their interaction on the quality of Red pepper chilli (*Capsicum annum* L) seedlings, the results were conducted using Factorial analysis of variance (ANOVA) was performed on the data for germination percentage**.** The Least significance difference (LSD) were calculated and the probability of treatment means being significantly different was set at P = 0.05.

RESULT AND DISCUSSION

A Germination Survival Percentage

The results of observations 30 days after sowing showed that the seeds aerated in the laboratory room had almost the same percentage of survival, namely 95% and 97% in the treatment aerated for 1 day and 7 days. Meanwhile, seeds that were dried in the sun for 1 day and 7 days showed a survival percentage of 82% and 10% respectively, However, the parameters were found significant in terms of drying applications ($p<0,05$)(see table l).

Tabel l. Persentase Hidup Benih cabai Besar (*Capsicum annum* L.)

Drying System (P)	Time Drying (D)		Average (P)
	1 day	7 day	
Laboratory (p1)	97%	95%	96%
Sun drying (p2)	82%	10%	46%
Average D	84.5%	50.2%	-

The seeds undergo thermal stress during the drying process, which causes inner damage of the seed structure, lowering or total loss of germination and vitality in inappropriate thermal and time modes of drying (Kermando, 1990). Drying is a method to reduce the moisture content of seeds which aims to reduce the rate of respiration and metabolism of seeds, so that the seeds can maintain their quality for a longer time. Seed drying can be done by several methods, namely by drying in the sun (sun drying) or by flowing hot air in a box dryer or oven. Both drying methods can have different effects on the seeds, because the temperature applied to the seeds is different for each method. For this reason, drying seeds must pay attention to the safe and best drying temperature so that the viability of the seeds remains high. This research on drying and shelf life of soybean seeds refers to the viability and vigor of seeds by giving different drying temperature treatments and shelf life for several varieties of chilli seeds.

Drying seeds, as well as contributing to the preservation of physiologic, enables the early harvest of the same, being primordial water content in determining the appropriate time of harvest, thus, several drying methods have been employed to assess the desiccation tolerance of seeds; among these, natural drying is the most widely used method. The length of the drying and storage process will cause a decrease in water content and germination, fat content in seeds tends to increase and decrease carbohydrate levels and protein levels in seeds, coming about in seeds losing vitality for germination (Yuniarti, et al 2016).

Seed drying could be a non-linear handle due to the long time allotment included and its impressive complexity. The drying phenomenon is based on the moisture removal from the interior of the food by drying air, requiring the knowledge of the initial and final (equilibrium) content of moisture of the material, relationship of water with the solid structure and transport of water from the interior of the material to its surface (Park et al., 2001).

Outstandingly, the IMC, dryer plan, drying temperature, and drying rate are imperative parameters influencing seed vigor in reaction to hot discuss drying. Among them, drying temperature plays a key part in keeping up seed vigor, and essentially influences the drying rate and seed temperature. Drying seed at a tall temperature may actuate harm, counting stretch splits, which brings down germination and crushes particular chemicals (Gawrysiak-Witulska et al., 2019). Drying at tall temperature also decreases seed vigor through smothering catabolism within the endosperm. Drying in direct sunlight is the simplest and most common drying method. Direct sunlight also can adversely affect seed germinability owing to high temperature and ultraviolet radiation, especially if the moisture content of the seed is high.

The downside is that the solar energy cannot be controlled, so it often has an adverse effect on the seeds. As the seeds dry out too quickly, the impermeability of the seed coat changes. The outside becomes dry and hard but the inside is still wet. This leads to a form of enforced dormancy known as "case hardening". This dormancy causes the percentage of germination to be low. It also causes uneven seed drying. In sun drying for too long (7 days), the water content in the seeds is too low and it is very possible that the embryo in the seed dies.

In the conventional dryer, the grain is constantly under the action of heat until moisture content reaches the desired value. The product passes through a flow regulating mechanism that determines the exposure time to air drying, also called residence time. Continuous drying is suited for large amounts of product and has the advantage of reducing the total drying time due to elimination of steps of loading and unloading of the dryer. On the other hand, during continuous flow drying, there is a difference between moisture located on the surface and that inside the seed **(**Souza e Silva, 2008). The surface which is in direct contact with the air dries more than the central part. This is the reason why seeds dried in direct sunlight have a low germination percentage (Table l).

Increase in the drying period caused a reduction in the seed moisture content and; consequently, the percentage of seedling emergence, when *C. Annum* L seeds were dried in a greenhouse environment. The results of research by Alves et al (2017) on *Crataeva tapia* L. show that the highest emergence level (86%) was for the treatment of zero hours (no drying), which reduced to 67% after 120 hours of drying, with the water content at around 12%. The data from drying seeds in a laboratory environment did not fit polynomial regression models, and reported an average emergence of 87%. When comparing the two drying environments it has been found that the seeds were less affected by drying in a laboratory environment, once the mean emergence of seedlings obtained dry seeds in this environment were statistically superior, except at zero time (Table 2). At the same time we can assume, that with rising temperature of drying air and rising humidity of seeds the germination decreases.

B. Height of Seedlings 30 Days after Transplanting

The observation results 30 days after transplanting from the nursery showed that the seedlings obtained from seeds dried in the laboratory room and dried in the sun at different drying times were not significantly different. Seedling growth was relatively uniform, with an average height of 112 mm. For more details, see Table 2 below:

Tabel 2. The height of seedlings 30 days after transplanting from the nursery

Drying System (P)	Time Drying (D)		Average (P)
	1 day	7 day	
Laboratory (p1)	115 mm	114 mm	114 mm
Sun drying (p2)	112 mm	109 mm	111 mm
Average D	113 mm	112mm	-

According to the results obtained in this study, seed vigour influenced the frequency of germination in all cultivars, followed by the duration in which the seeds were stored. The decrease in seed vigour determined the level of activity, the performance of seeds during in vitro germination, and seedling development. As previously indicated, any losses of seed vigour calculated as indicated in table 2 could be directly correlated with a reduction in seed germination and seedling development. This analysis on the germination frequency revealed a relationship between germination set against storage duration and seed vigour (Bajusa, et al 2019; Mongena, 2021)

Seed germination is considered as one of the most critical stages for successful seedling establishment, efficient plant growth and development. Successful germination depends upon a number of factors that include the moisture content of the seeds, and growth conditions such as humidity as well as temperature (Bertin et al 2020; Savage and Bassel, 2016). Because seeds maintain their quality better at a low moisture level, mechanical drying is frequently necessary to reduce their moisture content to a safe level. However, if a mechanical drying system is not properly managed, the germination of seeds can be damaged considerably during the drying period (Nezar S. 2005). Physico-mechanical properties of seeds are determined either genetically and also are influenced by a number of factors that act upon them during the growth and development of the parent plant (precipitation, nutrition, climatic conditions, soil type) during harvesting, post-harvest treatment, storing until they are planted (Banful, 2011; Chowdhury, 2003 in Bajusa et al, 2018).

Sprouts that have been obtained from healthy seeds will produce seedlings that should grow with good vigour. This is because the conditions in which the seedlings grow are relatively uniform, including the conditions of the growing medium and the environment. Moreover, during the nursery period, the seedlings are covered with 60% paranet, which means that reducing the intensity of irradiation by 40% will cause the environmental conditions to be relatively stable and controlled, especially the factors of air temperature and humidity.

Temperature and moisture (humidity) availability significantly affect the activity of biological and biochemical enzymes at the stage of germination and seedling growth (Bajusa et al, 2019). The moisture content of seed has a strong bearing on its keeping quality and its longevity in storage. In addition it causes heat and water production as a result of respiration; influences the levels of seed vigour and germination. In particular, temperature is one of the most important factors for seed germination, and affects all individual reactions and stages of germinatalion (Agha et al 2017; Erdogan et al 2017)

CONCLUSIONS

The study of the drying process Chilli seed is important, because with them we can optimize the drying process on suitable temperature and time, improving the final quality of the germination and the growing rate for the seedling vigorous process. Based on the results of the above research, it can be concluded that the drying temperature affected the germination after drying. The lower the drying temperature, the higher the seed germination energy, good germination of Red pepper chilli (*C. annum* L.) seeds is obtained from seeds that are dried in the room for l-7 days.

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EFFECT OF DURATION AND TYPE OF DRYING ON CHILLI SEEDS TOWARD THE QUALITY OF GERMINATION OF CHILLI (CAPSICUM ANNUM L.)[U1]

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Abstract. Red peppr is a type of chili that is needed by the community, especially for cooking ingredients and the food sources in Indonesia. There is a need to improve the quantity and quality of domestic red pepper production. In this case, seeds processing be one of factors that can affect the quality of red pepper production, one of them is drying. Drying is a method to reduce the seed moisture content which aims to decrease the respiration rate and the metabolic rate of the seed, so that the seed can be maintained for a longer period of time. The obyectives of experiment were the effect of drying on the germination of Chilli red pepper (Capsicum annum L.). The experiment was conducted at -field laboratory Faculty of Agriculture. The experimental design used was faclorial experiment 2 x 2 aruanged in Complelely Randomized Design (CRD) with replications four times. The first factor-was, drying (D) narnely: room drying (dl) and sun drying (d2). The second factor was drying period (P) namely: I days (pl) and 7 days (p2). The result showed lhat the drying and drying period was afected significanls on the germination.
Keywords: *seed, drying, germinatiory, red pepper*

Introduction

The most basic thing in Red Pepper Chilli production is the use of seeds. To produce good red pepper chilli, the seeds used must be superior and of high quality. According to Setiawan, (2014)[U3] the requirements of high quality seeds are: (1) pure and known varieties; (2) have high germination (>80%); (3) have good vigor, which can grow quickly and synchronously, and the sprouts are healthy; (4) clean and not mixed with grass seeds, seed debris or seeds of other plants; (5) healthy, not infected with fungi that can cause the sprouts to rot; (6) pithy, not wrinkled, no traces of insect bites, and have been completely dried out. Most of the farmers have realised that the use of good quality seeds will enhance the quality and quantity of their farming products. Often times, farmers experience significant losses in both cost and valuable time due to the use of poor and inferior seeds. In many areas when seeds are harvested they are often insufficiently dry for storage until the following planting season. In many areas when seeds are harvested they are often insufficiently dry for storage until the following planting season. It can be briefly stated that the problems in the field of seed technology mostly lead to aspects in the field of seed production, processing, storage and testing (Yuniarti and Nurhasybi, 2015). The seeds themselves should represent the performance of several factors such as varietal correctness, "germination percentage, grain percentage, vigour, freedom from pests and diseases and other contaminants". Seed failure to achieve one or more of these characteristics may indicate poor quality seed.

Traditionally, seed selection is done at the time of harvest, the fruit as prospective seeds taken for storage and later planting again must be obtained and derived directly from the selected plant. Seeds must be harvested on time to ensure high seed vigour, and are then dried (Yuniarti and Nurhasybi, 2015).

Seed quality consists of genetic quality, physical quality and physiological quality Physiological quality of seedsmdescribes the ability of seeds to grow into normal plants even after storage. The availability of chilli seeds is very important. This is because seeds are the limiting factor in increasing chilli production. One of the important information in determining seed quality quality is the level of seed vigour. Good seeds good seeds are seeds that have high vigour i.e. seeds that are able to grow and produce normally on the able to grow and produce normally in sub optimum conditions. Seeds are declared good quality if the seeds have high germination percentage, high growth vigour, and free from pests and diseases. Seeds are said to be healthy if the seeds are free from pathogens, either bacteria, fungi, viruses and nematodes (Finch-Savage and Bassel, 2016):

Three major factors affecting the germination of seed during mechanical drying are the initial moisture content of the seed, the temperature employed, and the length of time the seeds are exposed to the heated air. The seed drying process is carried out in various forms and ways, depending on the type of seed, length of storage, environmental conditions and local customs. The most commonly used drying methods are sun drying and air drying. How to dry the seeds so that they are not damaged is a matter of technology. A seed crop is often harvested when the seed moisture content is higher generally 14% or less is considered satisfactory for short term storage (Jäkel and Witzler, 2018). Seeds are also susceptible to drying injury in several ways; they are sensitive to high temperatures, depending on the species (Bajus et al., 2019; Agha et al., 2017). Seeds may also be injured by drying too rapidly or by over drying. To obtain a good dryer performance seed moisture content, depth of seed in bin, air temperature and air volume must be controlled (Krestini et al., 2017). A farmer wants to dry seed quickly, but high temperature may cause damage seed viability and vigour. The effect of high temperature is most damaging when the moisture content of the seed is high. The goal of the entry is to point out the impact of drying temperature on the seed quality of the food industry when it comes to micro-damage. For this reason, this study was conducted with the aim of determining the effect of drying system and duration on seed survival per cent and seedling quality.

Materials and Methods

1. Preparing the seed

Figure 1. Making traditional Red pepper seeds

The materials (seed) used in this study were red pepper chilli seeds (*Capsicum annum* L.). In chilli seed processing, extraction of to separate the seeds from the chilli skin. Seed extraction is an action to separate the seeds of prospective seeds from the fruit so that the seeds are obtained in a clean state. clean. The seeds were extracted from the fruits

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seeds are obtained by traditional methods, from healthy chilli fruits with excellent appearance (free of pests, fresh, large and evenly red in colour). using large chillies that are deliberately treated for seed trees sothat they can produce their own chillies. All seeds were then put in a container filled with water (figure 1) Those that floated on the surface of the water, representing non-viable seeds were discarded. harvest physiologically ripe chilli fruits.

2. Conducting Research

The experiment as well as the seed collection process was conducted at the Basic Science Laboratory and Field Laboratory of the Faculty of Agriculture, University of 17 Agustus 1945 Samarinda for 12 weeks. The design of this research is a completely randomised design (CRD). CRD is a design that is generally suitable for homogeneous conditions, tools, materials, and media. This condition is only achieved in controlled environments such as laboratories and greenhouses. In the condition of replicate data is a whole unit and the number of replicates in each treatment is assumed to be the same.

An Experiment design was Factorial Designs 2 x 2 method was used in this research and replicated five times. The first factor is the drying system (D) consisting of 2 levels, namely: air-dried in the room (d1) and sun-dried (d2). The second factor is the duration of drying (P) consisting of 2 levels, namely: dried for 1 day (p1) and dried for 7 days (p2).

Data collected included: (1) Percentage of germinated seeds, 30 days (4 weeks) after sowing (based on the definition of germination according to the Seed Certification and Supervision Centre; the term "germination" means the percentage of seeds capable of producing normal seedlings under ordinarily favorable conditions (not including seeds which produce week, malformed, or obviously abnormal sprouts); and (2) Height of 30-day-old seedlings (4 weeks). To determine the effect of drying and duration of drying and their interaction on the quality of Red pepper chilli (*Capsicum annum* L) seedlings, the results were conducted using Factorial analysis of variance (ANOVA) was performed on the data for germination percentage. The Least significance difference (LSD) were calculated and the probability of treatment means being significantly different was set at P=0.05.

Results and Discussion

Germination survival percentage

The results of observations 30 days after sowing showed that the seeds aerated in the laboratory room had almost the same percentage of survival, namely 95% and 97% in the treatment aerated for 1 day and 7 days. Meanwhile, seeds that were dried in the sun for 1 day and 7 days showed a survival percentage of 82% and 10% respectively, However, the parameters were found significant in terms of drying applications ($p<0,05$)(*Table l*). The seeds undergo thermal stress during the drying process, which causes inner damage of the seed structure, lowering or total loss of germination and vitality in inappropriate thermal and time modes of drying (Kermode, 1990). Drying is a method to reduce the moisture content of seeds which aims to reduce the rate of respiration and metabolism of seeds, so that the seeds can maintain their quality for a longer time. Seed drying can be done by several methods, namely by drying in the sun (sun drying) or by flowing hot air in a box dryer or oven. Both drying methods can have different effects on the seeds, because the temperature applied to the seeds is different for each method. For this reason, drying seeds must pay attention to the safe and best drying temperature so that the viability of the seeds remains high. This research on drying and shelf life of soybean seeds refers to the viability and vigor of seeds by giving different drying temperature treatments and shelf life for several varieties of chilli seeds.

Table 1. *Percentage survival of chilli seeds (Capsicum annum L.).*

Drying system (P)	Time drying (D) (in percentage %)		Average (P)
	1 day	7 days	
Laboratory (p1)	97	95	96
Sun drying (p2)	82	10	46
Average (D)	84.5	50.2	-

Drying seeds, as well as contributing to the preservation of physiologic, enables the early harvest of the same, being primordial water content in determining the appropriate time of harvest, thus, several drying methods have been employed to assess the desiccation tolerance of seeds; among these, natural drying is the most widely used method. The length of the drying and storage process will cause a decrease in water content and germination, fat content in seeds tends to increase and decrease carbohydrate levels and protein levels in seeds, coming about in seeds losing vitality for germination (Yuniarti et al., 2016). Seed drying could be a non-linear handle due to the long time allotment included and its impressive complexity. The drying phenomenon is based on the moisture removal from the interior of the food by drying air, requiring the knowledge of the initial and final (equilibrium) content of moisture of the material, relationship of water with the solid structure and transport of water from the interior of the material to its surface (Park et al., 2001). Outstandingly, the IMC, dryer plan, drying temperature, and drying rate are imperative parameters influencing seed vigor in reaction to hot discuss drying. Among them, drying temperature plays a key part in keeping up seed vigor, and essentially influences the drying rate and seed temperature. Drying seed at a tall temperature may actuate harm, counting stretch splits, which brings down germination and crushes particular chemicals (Wawrzyniak et al., 2019). Drying at tall temperature also decreases seed vigor through smothering catabolism within the endosperm. Drying in direct sunlight is the simplest and most common drying method. Direct sunlight also can adversely affect seed germinability owing to high temperature and ultraviolet radiation, especially if the moisture content of the seed is high.

The downside is that the solar energy cannot be controlled, so it often has an adverse effect on the seeds. As the seeds dry out too quickly, the impermeability of the seed coat changes. The outside becomes dry and hard but the inside is still wet. This leads to a form of enforced dormancy known as "case hardening". This dormancy causes the percentage of germination to be low. It also causes uneven seed drying. In sun drying for too long (7 days), the water content in the seeds is too low and it is very possible that the embryo in the seed dies. In the conventional dryer, the grain is constantly under the action of heat until moisture content reaches the desired value. The product passes through a flow regulating mechanism that determines the exposure time to air drying, also called residence time. Continuous drying is suited for large amounts of product and has the advantage of reducing the total drying time due to elimination of steps of loading and unloading of the dryer. On the other hand, during continuous flow drying, there is a difference between moisture located on the surface and that inside the seed (de Sousa et al., 2008). The surface which is in direct contact with the air dries more than the central part. This is the reason why seeds dried in direct sunlight have a low germination percentage (*Table l*).

Height of seedlings 30 days after transplanting

Increase in the drying period caused a reduction in the seed moisture content and; consequently, the percentage of seedling emergence, when C. Annum L seeds were dried in a greenhouse environment. The results of research by Alves et al. (2017) on Crataeva tapia L. show that the highest emergence level (86%) was for the treatment of zero hours (no drying), which reduced to 67% after 120 hours of drying, with the water content at around 12%. The data from drying seeds in a laboratory environment did not fit polynomial regression models, and reported an average emergence of 87%. When comparing the two drying environments it has been found that the seeds were less affected by drying in a laboratory environment, once the mean emergence of seedlings obtained dry seeds in this environment were statistically superior, except at zero time (*Table 2*). At the same time we can assume, that with rising temperature of drying air and rising humidity of seeds the germination decreases. The observation results 30 days after transplanting from the nursery showed that the seedlings obtained from seeds dried in the laboratory room and dried in the sun at different drying times were not significantly different. Seedling growth was relatively uniform, with an average height of 112 mm (*Table 2*).

***Table 2**. The height of seedlings 30 days after transplanting from the nursery.*

Drying system (P)	Time drying (D) (in mm)		Average (P)
	1 day	7 days	
Laboratory (p1)	115	114	114
Sun drying (p2)	112	109	111
Average (D)	113	112	-

According to the results obtained in this study, seed vigour influenced the frequency of germination in all cultivars, followed by the duration in which the seeds were stored. The decrease in seed vigour determined the level of activity, the performance of seeds during in vitro germination, and seedling development. As previously indicated, any losses of seed vigour calculated as indicated in *Table 2* could be directly correlated with a reduction in seed germination and seedling development. This analysis on the germination frequency revealed a relationship between germination set against storage duration and seed vigour (Mangena, 2021; Bajus et al., 2019). Seed germination is considered as one of the most critical stages for successful seedling establishment, efficient plant growth and development. Successful germination depends upon a number of factors that include the moisture content of the seeds, and growth conditions such as humidity as well as temperature (Yao et al., 2020; Finch-Savage and Bassel, 2016). Because seeds maintain their quality better at a low moisture level, mechanical drying is frequently necessary to reduce their moisture content to a safe level. However, if a mechanical drying system is not properly managed, the germination of seeds can be damaged considerably during the drying period (Samarah, 2005). Physico-mechanical properties of seeds are determined either genetically and also are influenced by a number of factors that act upon them during the growth and development of the parent plant (precipitation, nutrition, climatic conditions, soil type) during harvesting, post-harvest treatment, storing until they are planted (Bajus et al., 2019; Banful et al., 2011).

Sprouts that have been obtained from healthy seeds will produce seedlings that should grow with good vigour. This is because the conditions in which the seedlings grow are relatively uniform, including the conditions of the growing medium and the environment. Moreover, during the nursery period, the seedlings are covered with 60% paranet, which means that reducing the intensity of irradiation by 40% will cause the environmental conditions to be relatively stable and controlled, especially the factors of air temperature and humidity. Temperature and moisture (humidity) availability significantly affect the activity of biological and biochemical enzymes at the stage of germination and seedling growth (Bajus et al., 2019). The moisture content of seed has a strong bearing on its keeping quality and its longevity in storage. In addition it causes heat and water production as a result of respiration; influences the levels of seed vigour and germination. In particular, temperature is one of the most important factors for seed germination, and affects all individual reactions and stages of germinatalion (Agha et al., 2017; Erdoğan and Eşref, 2017).

Conclusion

The study of the drying process Chilli seed is important, because with them we can optimize the drying process on suitable temperature and time, improving the final quality of the germination and the growing rate for the seedling vigorous process. Based on the results of the above research, it can be concluded that the drying temperature affected the germination after drying. The lower the drying temperature, the higher the seed germination energy, good germination of Red pepper chilli (*C. annum* L.) seeds is obtained from seeds that are dried in the room for l-7 days.

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Conflict of interest

The authors confirm that there is no conflict of interest involve with any parties in this research study.

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EFFECT OF SEED DRYING ON THE QUALITY OF GERMINATION OF CHILLI (CAPSICUM ANNUM L.)

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Abstract. Red peppr is a type of chili that is needed by the community, especially for cooking ingredients and the food sources in Indonesia. There is a need to improve the quantity and quality of domestic red pepper production. In this case, seeds processing be one of factors that can affect the quality of red pepper production, one of them is drying. Drying is a method to reduce the seed moisture content which aims to decrease the respiration rate and the metabolic rate of the seed, so that the seed can be maintained for a longer period of time. The obyectives of experiment were the effect of drying on the germination of Chilli red pepper (Capsicum annum L.). The experiment was conducted at -field laboratory Faculty of Agriculture. The experimental design used was faclorial experiment 2 x 2 aruanged in Complelely Randomized Design (CRD) with replications four times. The first factor-was, drying (D) narnely: room drying (dl) and sun drying (d2). The second factor was drying period (P) namely: I days (pl) and 7 days (p2). The result showed lhat the drying and drying period was afected significanls on the germination.
Keywords: *seed, drying, germinatiory, red pepper*

Introduction

The most basic thing in Red Pepper Chilli production is the use of seeds. To produce good red pepper chilli, the seeds used must be superior and of high quality. According to Setiawan (2014) the requirements of high quality seeds are: (1) pure and known varieties; (2) have high germination (>80%); (3) have good vigor, which can grow quickly and synchronously, and the sprouts are healthy; (4) clean and not mixed with grass seeds, seed debris or seeds of other plants; (5) healthy, not infected with fungi that can cause the sprouts to rot; (6) pithy, not wrinkled, no traces of insect bites, and have been completely dried out. Most of the farmers have realised that the use of good quality seeds will enhance the quality and quantity of their farming products. Often times, farmers experience significant losses in both cost and valuable time due to the use of poor and inferior seeds. In many areas when seeds are harvested they are often insufficiently dry for storage until the following planting season. In many areas when seeds are harvested they are often insufficiently dry for storage until the following planting season. It can be briefly stated that the problems in the field of seed technology mostly lead to aspects in the field of seed production, processing, storage and testing (Yuniarti and Nurhasybi, 2015). The seeds themselves should represent the performance of several factors such as varietal correctness, "germination percentage, grain percentage, vigour, freedom from pests and diseases and other contaminants". Seed failure to achieve one or more of these characteristics may indicate poor quality seed. Traditionally, seed selection is done at the time of harvest, the fruit as prospective seeds

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taken for storage and later planting again must be obtained and derived directly from the selected plant. Seeds must be harvested on time to ensure high seed vigour, and are then dried (Yuniarti and Nurhasybi, 2015).

Three major factors affecting the germination of seed during mechanical drying are the initial moisture content of the seed, the temperature employed, and the length of time the seeds are exposed to the heated air. The seed drying process is carried out in various forms and ways, depending on the type of seed, length of storage, environmental conditions and local customs. The most commonly used drying methods are sun drying and air drying. How to dry the seeds so that they are not damaged is a matter of technology. A seed crop is often harvested when the seed moisture content is higher generally 14% or less is considered satisfactory for short term storage (Jäkel and Witzler, 2018). Seeds are also susceptible to drying injury in several ways; they are sensitive to high temperatures, depending on the species (Bajus et al., 2019; Agha et al., 2017). Seeds may also be injured by drying too rapidly or by over drying. To obtain a good dryer performance seed moisture content, depth of seed in bin, air temperature and air volume must be controlled (Krestini et al., 2017). A farmer wants to dry seed quickly, but high temperature may cause damage seed viability and vigour. The effect of high temperature is most damaging when the moisture content of the seed is high. The goal of the entry is to point out the impact of drying temperature on the seed quality of the food industry when it comes to micro-damage. For this reason, this study was conducted with the aim of determining the effect of drying system and duration on seed survival per cent and seedling quality.

Materials and Methods

Preparing the seed

The materials (seed) used in this study were red pepper chilli seeds (Capsicum annum L.). In chilli seed processing, extraction involve with separating the seeds from the chilli skin. Seed extraction is an action to separate the seeds of prospective seeds from the fruit so that the seeds are obtained in a clean state. The seeds were extracted from the fruits seeds are obtained by traditional methods, from healthy chilli fruits with excellent appearance (free of pests, fresh, large and evenly red in colour) using large chillies that are deliberately treated for seed trees so that they can produce their own chillies. All seeds were then put in a container filled with water (*Figure 1*). Those floated on the surface of the water, representing non-viable seeds were discarded harvest physiologically ripe chilli fruits.

Figure 1. *Making traditional Red pepper seeds.*

The experiment as well as the seed collection process was conducted at the Basic Science Laboratory and Field Laboratory of the Faculty of Agriculture, University of 17 Agustus 1945 Samarinda for 12 weeks. The materials (seed) used in this study were red pepper chilli seeds (Capsicum annum L.). The seeds were extracted from the fruits seeds are obtained by traditional methods, from healthy chilli fruits with excellent appearance (free of pests, fresh, large and evenly red in colour). All seeds were then put in a container filled with water. Those that floated on the surface of the water, representing non-viable seeds were discarded. Completely Randomized Design (CRD) An Experiment Factorial Design Pattern 2x2 method was used in this research and replicated five times. The first factor is the drying system (D) consisting of 2 levels, namely: air-dried in the room (d1) and sun-dried (d2). The second factor is the duration of drying (P) consisting of 2 levels, namely: dried for 1 day (p1) and dried for 7 days (p2).

Data collected included: (1) Percentage of germinated seeds, 30 days (4 weeks) after sowing (based on the definition of germination according to the Seed Certification and Supervision Centre; the term "germination" means the percentage of seeds capable of producing normal seedlings under ordinarily favorable conditions (not including seeds which produce week, malformed, or obviously abnormal sprouts); and (2) Height of 30-day-old seedlings (4 weeks). To determine the effect of drying and duration of drying and their interaction on the quality of Red pepper chilli (Capsicum annum L) seedlings, the results were conducted using Factorial analysis of variance (ANOVA) was performed on the data for germination percentage. The Least significance difference (LSD) were calculated and the probability of treatment means being significantly different was set at P=0.05.

Results and Discussion

Germination survival percentage

The results of observations 30 days after sowing showed that the seeds aerated in the laboratory room had almost the same percentage of survival, namely 95% and 97% in the treatment aerated for 1 day and 7 days. Meanwhile, seeds that were dried in the sun for 1 day and 7 days showed a survival percentage of 82% and 10% respectively, However, the parameters were found significant in terms of drying applications ($p<0,05$)(*Table l*). The seeds undergo thermal stress during the drying process, which causes inner damage of the seed structure, lowering or total loss of germination and vitality in inappropriate thermal and time modes of drying (Kermode, 1990). Drying is a method to reduce the moisture content of seeds which aims to reduce the rate of respiration and metabolism of seeds, so that the seeds can maintain their quality for a longer time. Seed drying can be done by several methods, namely by drying in the sun (sun drying) or by flowing hot air in a box dryer or oven. Both drying methods can have different effects on the seeds, because the temperature applied to the seeds is different for each method. For this reason, drying seeds must pay attention to the safe and best drying temperature so that the viability of the seeds remains high. This research on drying and shelf life of soybean seeds refers to the viability and vigor of seeds by giving different drying temperature treatments and shelf life for several varieties of chilli seeds.

***Table 1**. Percentage survival of chilli seeds (Capsicum annum L.).*

Drying system (P)	Time drying (D) (in percentage %)		Average (P)
	1 day	7 days	
Laboratory (p1)	97	95	96
Sun drying (p2)	82	10	46
Average (D)	84.5	50.2	-

Drying seeds, as well as contributing to the preservation of physiologic, enables the early harvest of the same, being primordial water content in determining the appropriate time of harvest, thus, several drying methods have been employed to assess the desiccation tolerance of seeds; among these, natural drying is the most widely used method. The length of the drying and storage process will cause a decrease in water content and germination, fat content in seeds tends to increase and decrease carbohydrate levels and protein levels in seeds, coming about in seeds losing vitality for germination (Yuniarti et al., 2016). Seed drying could be a non-linear handle due to the long time allotment included and its impressive complexity. The drying phenomenon is based on the moisture removal from the interior of the food by drying air, requiring the knowledge of the initial and final (equilibrium) content of moisture of the material, relationship of water with the solid structure and transport of water from the interior of the material to its surface (Park et al., 2001). Outstandingly, the IMC, dryer plan, drying temperature, and drying rate are imperative parameters influencing seed vigor in reaction to hot discuss drying. Among them, drying temperature plays a key part in keeping up seed vigor, and essentially influences the drying rate and seed temperature. Drying seed at a tall temperature may actuate harm, counting stretch splits, which brings down germination and crushes particular chemicals (Wawrzyniak et al., 2019). Drying at tall temperature also decreases seed vigor through smothering catabolism within the endosperm. Drying in direct sunlight is the simplest and most common drying method. Direct sunlight also can adversely affect seed germinability owing to high temperature and ultraviolet radiation, especially if the moisture content of the seed is high.

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Height of seedlings 30 days after transplanting

Increase in the drying period caused a reduction in the seed moisture content and; consequently, the percentage of seedling emergence, when C. Annum L seeds were dried in a greenhouse environment. The results of research by Alves et al. (2017) on Crataeva tapia L. show that the highest emergence level (86%) was for the treatment of zero hours (no drying), which reduced to 67% after 120 hours of drying, with the water content at around 12%. The data from drying seeds in a laboratory environment did not fit polynomial regression models, and reported an average emergence of 87%. When comparing the two drying environments it has been found that the seeds were less affected by drying in a laboratory environment, once the mean emergence of seedlings obtained dry seeds in this environment were statistically superior, except at zero time (*Table 2*). At the same time we can assume, that with rising temperature of drying air and rising humidity of seeds the germination decreases. The observation results 30 days after transplanting from the nursery showed that the seedlings obtained from seeds dried in the laboratory room and dried in the sun at different drying times were not significantly different. Seedling growth was relatively uniform, with an average height of 112 mm (*Table 2*).

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