Allium cepa L.

Monograph

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Introduction

In this monograph, I am going to be talking about a vegetable humans use and consume in different ways all around the world on a daily basis. You will be able to find in-depth research about onions focusing on their ecology, biology, propagation, and management, and value chain and applications. The onion (Allium cepa L) is an important condiment that is used all year in all households. The immature and mature bulbs, as well as the green leaves, are eaten raw or used in vegetable preparation. Onions are used to flavor soups, sauces, and other dishes.

1.0 Ecology

1.1 Distribution

Allium cepa is native to Afghanistan and Iran; cultivated around the world. Although temperate in origin, it has been bred to adapt to the tropics (Ross, 2001). It is distributed throughout Nepal to about 3000m (Manandhar, 2002). They are not found in New Zealand and Australia (Anonymous, 2006).

Focusing on Colombia, where it is a strategic crop due to its economic relevance within fresh and processed food markets, and therefore, there is a demand for high-yielding genotypes adapted to specific regions. After carrying out a study with the purpose of identification, evaluation, and selection of promising clones from the Colombian Germplasm Bank. To identify elite materials adapted to the current bunching onion growing areas in Colombia, with tolerance to diseases and fitted to farmers and market preferences. Which included 62 different genotypes, ten of these, including a regional control, were evaluated for six different traits in Boyacá, Colombia, between 2012 and 2013. (Galeano et al., 2018).

The results showed that Boyacá was the department that stood out from 2010 to 2015 with 70% of the national production, and the productive chain linked from small-scale farmers to the agroindustry, transportation actors, and the final market. (Galeano Mendoza et al., 2018). The study analyzes different traits like yield and processing categories. In general, these showed significant differences for genotypes, location, and genotypes plus location interaction. Compared with the regional control and based on the multi environmental analysis the genotypes Clone 30 and Clone 38 were the most promising new cultivars identified in this study. These two clones showed comparative advantages in earliness and yield and showed some level of resistance to downy mildew and root rot, the most limiting diseases for Boyacá's bunch onion farmers. (Galeano et al., 2018)

Figure 1: *World's Leading Onion Producing Countries, 1970*

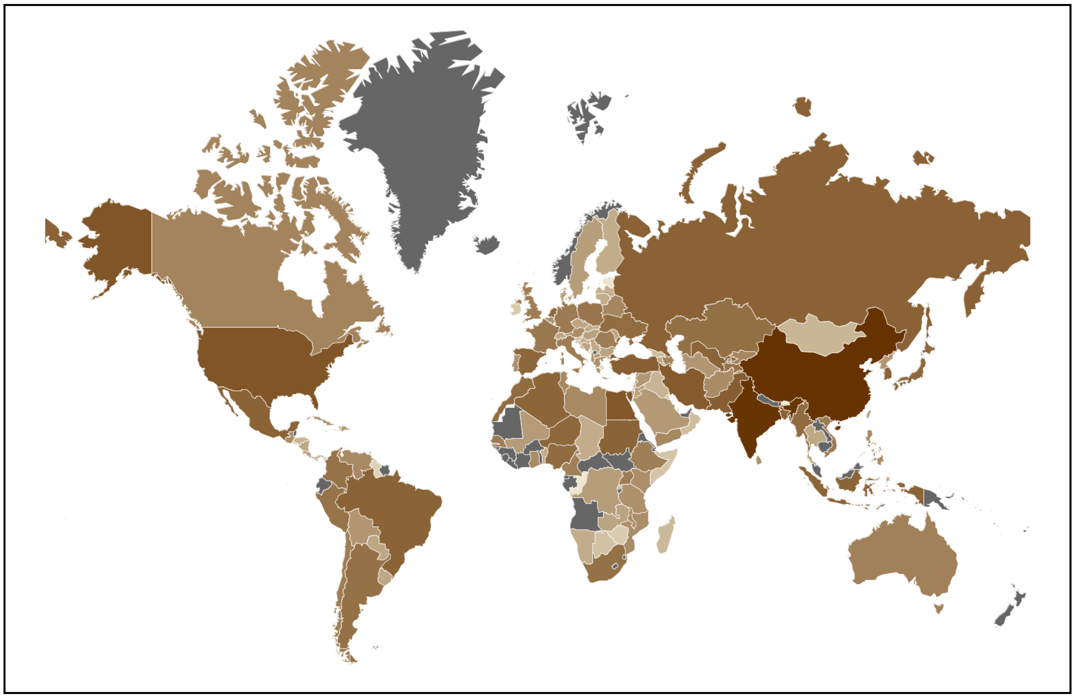
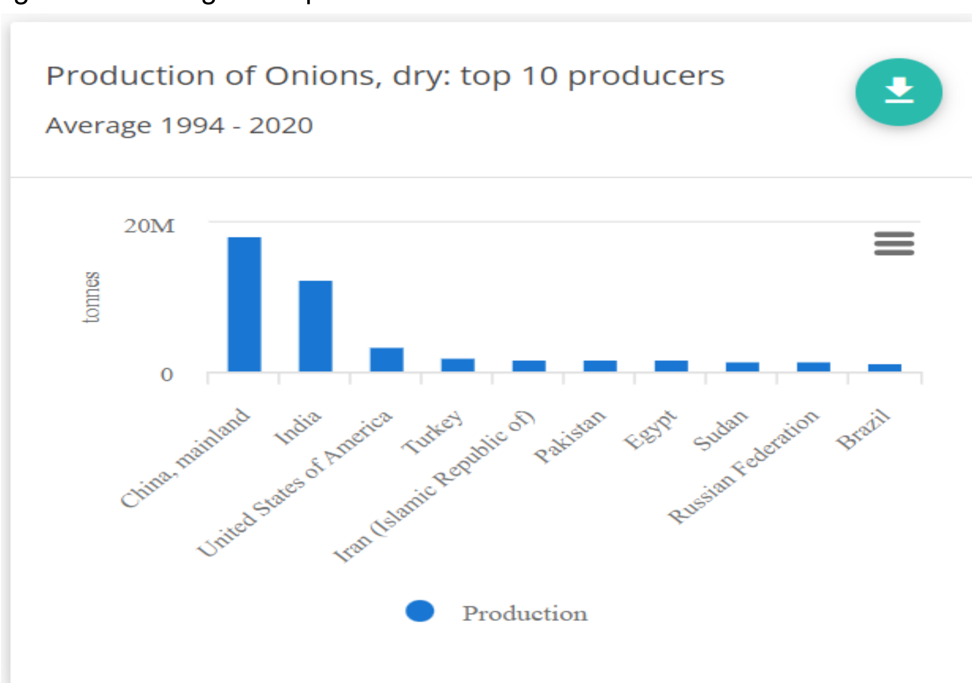


Figure 2. Leading onion production Contries.

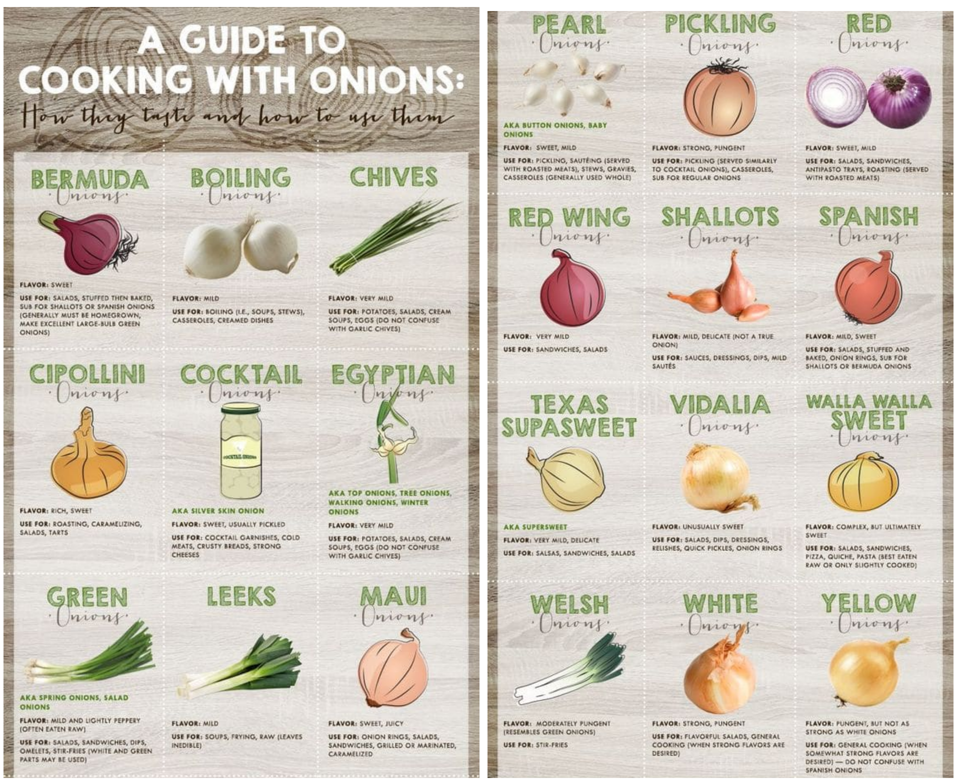


1.2 Affinities

Onions and other aromatic plants belong to the *Allium* genus of the lily family. (James, n.d.). They are actually commonly known as "stink lilies" for their distinctive aromatic properties. There is a wide range of species within the genus Allium. They include onions, leeks, garlic, chives, and shallots.

If we focus only on Onion, we can name 8 species, and 21 different types (Figure X below). Which are; Bermuda onions, Boiling onions, Chives, Cipollini onions, Cocktail onions, Egyptian onions, Green onions, Leeks, Maui onions, Pearl onions, Pickling onions, Red onions, Red Wing onions, Shallots, Spanish onions, Texas supersweet onions, Vidalia onions, Walla Walla Sweet onions, Welsh onions, White onions, Yellow onions. (*21 Types of Onions and How to Use Them*, n.d.)

Figure 3.*21 Types of Onions and How to Use Them* (reference Misfits, 2020)



Common onion (*Allium cepa* L.) is one of the oldest cultivated plants, utilized worldwide as both vegetable and flavoring. Some related species are Potato or Multiplier onion, Allium cepa. Its close relatives include garlic, scallion, leek, chive, and Chinese onion. This genus also contains several other species variously referred to as onions and cultivated for food, such as the

Japanese bunching onion (Allium fistulosum), the tree onion (A. proliferum), and the Canada onion (Allium canadense). (Song et al., 2007)

1.3 Taxonomy

With roughly 850 species, Allium is the sole genus in the Allieae (is a tribe of plants belonging to the subfamily Allioideae of the Amaryllis family (Amaryllidaceae). It comprises a single genus, Allium, distributed in temperate zones of the Northern Hemisphere., one of four tribes of the subfamily Allioideae (Amaryllidaceae). Although Allium is one of the largest monocotyledonous genera, the exact taxonomy of the genus is unclear, and erroneous descriptions are prevalent. The problems arise because the genus has a lot of variability and has adapted to a variety of habitats. Traditional classifications were based on homoplasious characteristics as well (the independent evolution of similar features in species of different lineages). Despite the fact that some proposed subgenera are not monophyletic, the genus as a whole has been shown to be monophyletic, having three major clades. Internal transcribed spacer and molecular phylogenetic techniques

1.4 Fossil Record

The research's premise. From the final early Eocene Republic flora of north-central Washington, fossil inflorescences (scapes) generating both pedicellate flowers and sessile bulbils, each partially covered by a persistent spathe, are documented. They are linked to a single bulb specimen with attached roots, as well as two little flower buds that appear to be from the same plant. The morphology of these fossils is quite similar to that of several bulb-forming monocots, such as some Allium species and other Amaryllidaceae members Methodology. (Pigg et al., 2018) To expose morphological characteristics, compression-impression fossils preserved in a lacustrine shale were recovered from the rock matrix and shot with LM. Specimens were morphologically compared to existing material of similar plants, and the resulting photos were minimally altered with Adobe Photoshop.

Figure 5: A–H, Paleoallium billgenseli. I, Extant Allium cepa var. proliferum. Variation in general overview of fossil specimens using extant Egyptian walking onion as a model. A, Holotype showing scape, spathe, small bulbils at apex, and several flowers; SR10-35-06. B, SR 10-07-06. Note somewhat flattened flowers; photograph inverted horizontally. C, SR 13-004-012. D, SR 11-31-07. E, SR 08-36-03. F, SR 08-41-43. G, SR 11-01-02A; inverted

horizontally. H, SR 08-40-10; inverted horizontally. I, Allium cepa var. proliferum. Habit shot in garden. Scale bars p 1 cm. (Pigg et al., 2018)

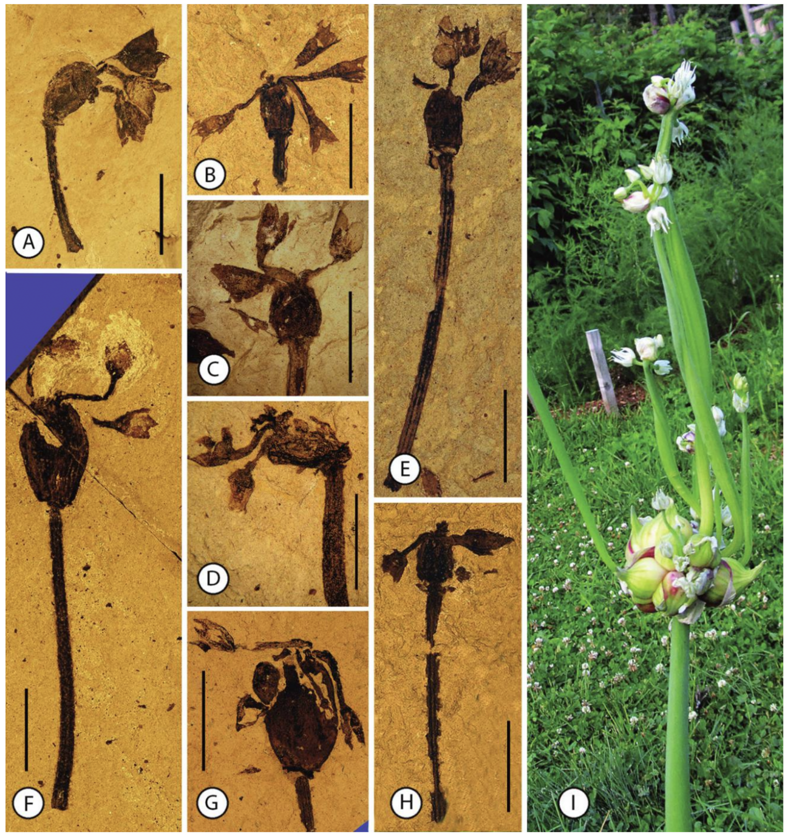
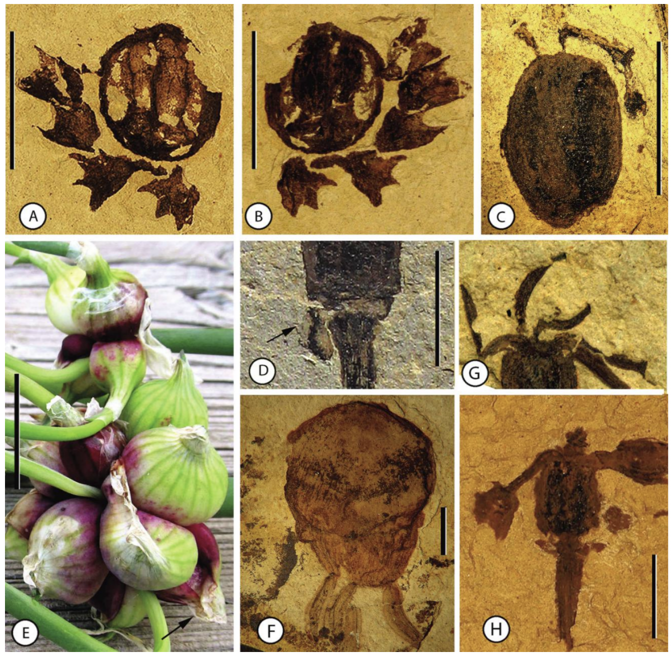


Figure 6. A–D, Paleoallium billgenseli. E, Allium cepa var. proliferum. A, B, Part-counterpart specimen of a larger bulbil, surrounded by four flowers; SR 00-05-23 AB. C, Spathe with two flowers; SR 11-31-06 A. D, Base of spathe showing shred of onion skin (pprotective leaf sensu Mann 1960; arrow); SR 08-36-03. E, Extant Allium cepa var. proliferum showing cluster of bulb and foliage leaves. F, Bulb with attached leaf bases and four attached roots; SR 13-004-010 A. G, Six flower pedicels bearing young or abortive flowers; 11-25-04. H, Spathe with subtending bracts; SR 08-04-10. Scale bars p 1 cm (A–C, F), 0.5 cm (D, G). (Pigg et al., 2018)



1.5 Origin

Several archaeologists, botanists, and food historians believe onions originated in Central Asia. Onions were first cultivated in Iran and West Pakistan, according to some findings. Long before farming or even writing, our predecessors are supposed to have discovered and eaten wild onions. This humble vegetable was almost certainly a staple in prehistoric diets. According to most academics, the onion has been produced for at least 5000 years. Because onions grew wild in numerous regions, they were actually consumed for thousands of years and farmed at the same time all across the world. (Onion History - National Onion Association, 2019). Onions may have been one of the first foods since they were less perishable than other foods at the time, were transportable, easy to cultivate, and could be grown in a variety of ways. According to traces found in Bronze Age towns in China, not only for their flavor but also for the bulb's resilience in storage and transportation. The onion bulb was treasured by ancient Egyptians, who saw its spherical shape and concentric rings as symbols of endless life. Onions were utilized in Egyptian funerals, as demonstrated by onion remnants discovered in Ramesses IV's eye sockets. (Song et al., 2022).

Onions is one of the world's earliest cultivated plants, going back to before 5,000 BC. The plant is thought to have originated in Central Asia, but it is now extinct in the wild. Onions are grown in temperate and subtropical climates all over the world (Woodward 1996). The species has a wide range of appearances, including color, shape, dry matter content, and pungency. This diversity is mirrored in the species' ability to adapt to a variety of situations (Griffiths et al. 2002). Onions are diploid (2n = 2x = 16), with a nuclear genome of 1.6109 base pairs per 1C, roughly the same as hexaploid wheat and 34 and 6 times larger than rice and maize, respectively (Arumuganathan and Earle 1991).

The geographic origin of the onion is unknown because the wild onion is gone, and historical records of onion use span western and eastern Asia, while domestication most likely took place in Southwest or Central Asia. Onions have been attributed to Iran, western Pakistan, and Central Asia, among other places.

In the first century AD, Pliny the Elder (a Roman author, naturalist and natural philosopher, naval and army commander of the early Roman Empire, and a friend of the emperor Vespasian.) wrote about the use of onions and cabbage in Pompeii. He detailed Roman ideas about the onion's power to treat anything from mouth ulcers and toothaches to dog bites, lumbago, and even dysentery. Garden like those described in Pliny's precise tales has been discovered by archaeologists digging Pompeii long after its 79 AD volcanic burial. (Song et al., 2022) Onions were employed in several Roman recipes, according to documents collected in the fifth/sixth centuries AD under the authorial auspices of "Apicius" (supposed to be a gourmet).

1.6 Environmental Factors in Distribution

Many factors influence pest dynamics in cultivated crops, both directly and indirectly, and recognizing the elements that drive a pest's population dynamics is an important part of pest control. The onion maggot, Delia Antiqua (Meigen) (Diptera: Anthomyiidae), is a major onion pest in temperate locations around the world. D. Antiqua is the most important early-season onion pest in North America's Great Lakes region, destroying plants and causing significant damage.

Despite the fact that producers use the same management and growth techniques, D. Antiqua plant damage varies greatly across the region. Other factors, such as temperature and precipitation, soil organic matter, surrounding landscape composition, planting date, and plant size at peak fly activity, may be important in explaining the disparities in damage across the region, and previous studies have indicated that temperature and precipitation, soil organic matter, surrounding landscape composition, planting date, and plant size at peak fly activity are all important factors affecting D. Antiqua. (a cosmopolitan pest of crops. The larvae or maggots feed on onions, garlic, and other bulbous plants.)

During a two-year period (2018–19), the aforementioned metrics were monitored in commercial onion farms in central and western New York, USA (n = 15; 2019: n = 13). There was a relationship between fly activity and plant damage in both years of the study. D. Antiqua wreaked havoc on onion fields that were largely surrounded by woodland rather than agricultural crops, and those that were planted late in the season rather than early. Plant damage was also connected to soil temperature and organic matter content, but these effects were context-dependent and only discovered in the study's first year.

Bulb onion flowers follow vernalization and generate a huge bulb in the first year of growth. During their growth and storage, onions are attacked by a variety of pests, illnesses, and viruses. One of the most significant goals of onion biotechnology is the control of onion pests and illnesses. The onion is dehydrated for food processing and eaten fresh as a green salad ingredient. It has also been utilized as a therapeutic substance for thousands of years.

1.7 Elevation and soil

The onion crop is a cool-season crop that is often planted in the winter and harvested shortly before summer arrives. Onions can withstand a wide range of weather conditions. Its cultivation, however, requires a calm season with little fluctuations of heat and cold. Between April and August, onions can be cultivated at elevations ranging from 1400 to 2000 meters (msl) in rainfed circumstances. *(2Lua.vn, 2017)*

Onions may be cultivated in a variety of soil types. For onion farming, however, red loam to black soils and sandy loam to silly loam with adequate drainage and deep friability are highly favored. For higher production, a soil pH of 5.5–6.5 with a warm season is preferable. Adding organic matter to the soil as part of the preparation process will increase onion bulb yield.

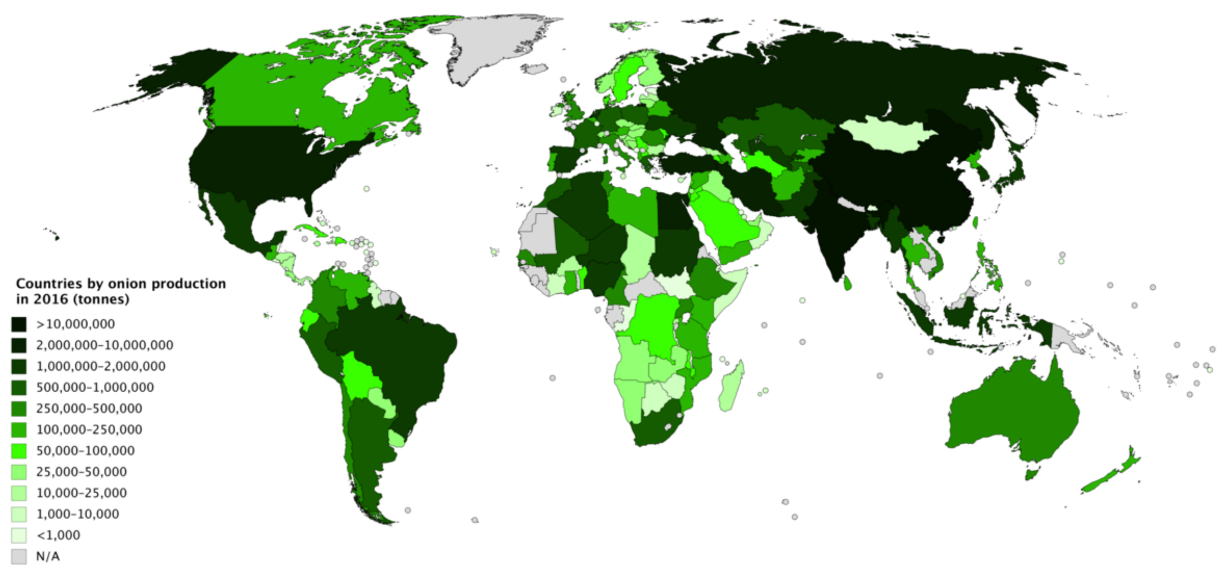
1.8 Climate & Temperature regime

In the field, *Allium cepa* L. was grown in polyethylene-covered tunnels with a temperature gradient enforced. 374 or 532 mol mol-1 CO_2 was maintained in pairs of tunnels. For each cultivar, the rates of progress from transplanting to bulbing, as well as from bulbing to harvest maturity, were positive linear functions of mean temperature. When compared to normal CO_2, the timing of bulbing was sooner, but the duration of bulb growth was longer, at a given temperature. CO_2, temperature, or cultivar had no effect on canopy architecture, and all treatment combinations had a canopy light extinction coefficient of 0.25. In the period leading up to bulbing, radiation usage efficiency was higher at raised CO_2 than at normal CO_2, but it remained the same at both CO_2 concentrations during subsequent bulb growth. Due to increasing CO_2, total crop dry weight at bulbing increased by 32-44 percent. Bulb yields at harvest maturity decreased as temperatures rose, and this was more pronounced in cv. Sito than in cv. Hysam. In the cvs Hysam and Sito, CO_2 enrichment improved bulb yields by 29-37 percent and 35-51 percent, respectively. From a comparison of the temperature rises required to completely offset each cultivar's production improvements owing to.

Cepa is cultivated under a wide range of conditions. The environmental conditions are latitude. It can be grown between 60ºS and 60ºN (URL-5). High temperatures encourage bulb formation, but flower formation and seed production are only possible where the bulbs are subjected to low temperatures. A cool period promotes early leaf production. Germination temperature is between 15-25ºC, optimal between 20-25. It grows between 4 and 30ºC and does not tolerate frost (URL-5).

A long, dry period is required for bulb reopening after the leaves have withered. Optimal rainfall/irrigation requirements are 350-600 mm and it is grown in areas with up to 2800 mm annual rainfall (URL-5). It is a sun-loving species (URL-5). Photoperiodism; The production of bulbs is controlled by the photoperiod, the critical day-length varies from 11-16 hours, depending on the cultivar (URL-5).

Figure 7: *Countries by onion production in 2016*



1.9 Geology and Soils

Onions will grow in almost any type of soil; a soil high in organic matter and well-drained is preferred. Add rotted manure, compost, or other organic matter the fall preceding the spring crop and work into the soil. Apply a fertilizer that is high in phosphorus and potassium such as 6-24-24 at 4 to 5 pounds per 100 square feet of garden area in the absence of soil test recommendations. On high fertility soils, the fertilizer application should be limited to a side-dressing application of nitrogen 2 to 3 weeks after planting. Moist soil is required throughout the growing period, but excessive soil water and high

Humidity encourages diseases. Best soils are medium-deep, well-drained, sandy loams with a good content of organic matter; they can also be in also any soil (URL-5).Best soils are medium fertility with low salinity and a pH between 6.0-7.0 but also soils with low fertility, some salinity, and a pH between 4.3-8.3 are feasible (URL-5).

1.10 Family prominence and floristic elements

The Liliaceae family includes roughly 700 species in the genus Allium, which includes both economically important plants and wild species. The plant can be found throughout a wide range of latitudes and altitudes in Europe, Asia, North America, and Africa, and is adapted to temperate areas with low or unpredictable water supply. In their initial year of growth, various Allium species generate an underground storage bulb and flower the following year. Garlic, unlike many other species, does not produce seeds. While economically important Allium species include A. cepa (bulb onion), A. sativum (garlic), and A. tuberosum (Chinese chives), additional Allium species are valuable locally

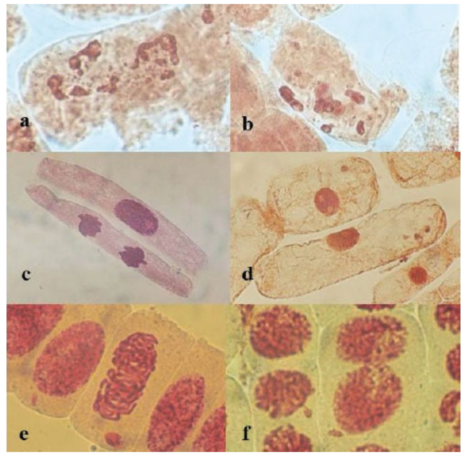
2.0 Biology

2.1 Chromosome complement

The tips of the roots Induced chromosomal aberrations (CAs) and the existence of micronuclei have been studied in a variety of plant species. The most common experimental material is root tips from various Allium species. In certain situations, plants have an edge over other organisms. Plants typically have big chromosomes and a low number of chromosomes. (Nefic et al., 2013) A large fraction of cells in mitosis are seen in the root meristem. Early studies of the genetic alterations caused by carcinogenic agents and radiation relied mostly on plant systems. *Allium cepa* L. is one of the best plants for detecting many forms of xenobiotics. Fiskesjö introduced the first adaptation of the *Allium cepa* test for environmental monitoring. (Nefic et al., 2013)

At all concentrations tested, alprazolam caused chromosomal (anaphase bridges, breaks, lagging and stickiness, abnormal spiralization, multipolarity and polyploidy) and cytological aberrations, particularly nuclear alterations (nuclear buds, fragmented nucleus and apoptotic bodies, cells without nucleus, binucleated and micronucleated cells), morphological changes in cell shape and size, spindle disturbance, and In these cells, alprazolam significantly reduced the mitotic index.(Nefic et al., 2013)

Figure . 8. Photomicrographs of cytological aberrations in Allium cepa meristem cells exposed to Alprazolam; (a–b) cells with fragmented nucleus and apoptotic bodies, morphological alterations in shape and size of cells; (c) extended interphase and telophase cell, dislocation of spindle, stickiness; (d) extended cells, disturbed spindle and cytoplasm destruction; (e) micronucleus in prophase, stickiness; (f) cells with nuclear bud (magnification: 1000×). (Nefic et al., 2013)



Alprazolam's possible genotoxic effects were investigated using onion root tip cells. The test was carried out with some modifications to the Fiskesjö protocol. The common onion has eight pairs of relatively big chromosomes (2n = 16), which makes CA identification fairly easy. Plant material is widely available all year, is affordable, and simple to grow and handle. Because of the size of chromosomes, *Allium cepa* tips are a good candidate for studying the impact of chemicals on the frequency of CAs, which are indicators of genetic material damage. (*Chromosome Damage Studies in the Onion Plant Allium Cepa L.*, 2014) The root tip cells show a low frequency of spontaneous aberrations and a consistent chromosomal number.

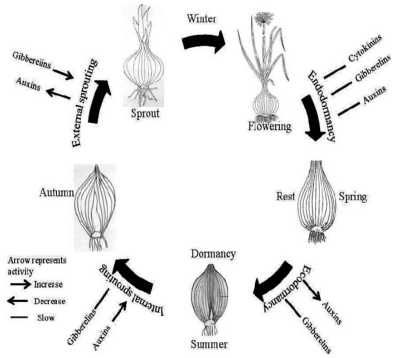
2.2 Life cycle and phenology

https://core.ac.uk/download/pdf/32326072.pdf

Thomas et al.(26) classified onion growth into three stages: entirely dormant bulbs, bulbs showing symptoms of sprouting when dissected, and bulbs with well-developed and actively growing leaves. Stage c had the most GA activity, while stage b had the highest auxin activity. (S.Kavita, L.Yong, P. Se Won, N. Shivraj 2016).Different hormone treatments on stored onion did not increase the number of sprouting bulbs or the period of sprout emergence, according to studies, although GA and 1-naphthaleneacetic acid affected root development (NAA).

The GA treatment promoted the formation of long, fine roots, but the NAA treatments resulted in roots that were significantly shorter and thicker than those of control bulbs.(S.Kavita, L.Yong, P. Se Won, N. Shivraj 2016) High GA activity during sprouting was caused by sprout elongation and the failure to apply gibberellic acid (GA3), which has been demonstrated to have no effect on bulb sprouting. Furthermore, alterations in bulb auxin activity were found to be more important in the actual dormancy breach. (S.Kavita, L.Yong, P. Se Won, N. Shivraj 2016)

Figure 9. Annual life cycle of onion with respect to the change in plant growth regulators. (S.Kavita, L.Yong, P. Se Won, N. Shivraj 2016)



Onions cultivated for seed production are grown similarly to onions grown for winter storage. During the second year of cultivation, it will produce seeds. Instead of utilizing bulbils, which flower too early, it will be preferable to sow the seeds and then transplant them to get onions to generate seeds. (*¿Cómo Producir Las Semillas de Cebolla? | ¡SIEMBRA!*, 2019)

Plants that flower during their first year of cultivation should be removed from consideration. Plants grown from these onions' seeds have a tendency to blossom too early.

During its first year, the common onion requires a mix of high temperatures and long days to form its bulb.

The plant and radicals sprout from the seed during germination, and the cotyledon (seed leaf) emerges with a looplike form through the soil surface at the end of this stage (Brewster 2008). After germination, the plant enters the leaf development stage, during which it grows its leaves (up to seven). The first leaf falls when the seventh appears, and the plant enters the bulbing stage (Brewster 2008). During this stage, the bulb begins to extend and new leaves (from the eighth to the thirteenth leaf) develop, and the plant reaches its maximum height, while the second and third leaves desiccate.

The bulb swelling stage follows, which is marked by fast bulb growth and the desiccation of the fourth-sixth leaf. The leaves may also bend or fold.

The best bulbs will be chosen at harvest time in order to obtain high-quality seeds. Winter conservation often results in losses, thus between twenty and thirty will be set aside so that fifteen to twenty can be planted later. They will be picked based on the variety's shape, color, and size features. They must be in good health and have smooth, wrinkle-free skin. Bulb clusters, doubles, and multiples will be discarded.

The following stage is the fall down stage, in which the foliage collapses due to its weight. Finally, the bulb's outer skin gets dry and the foliage desiccates during the bulb ripening stage.

The bulbs are then dried in a warm, well-ventilated area for ten to twelve days. To keep onions fresh, keep them in a cool, well-ventilated area. They will be checked on a regular basis during the winter to remove any that have rotted. The length of dormancy varies per variety, but it is broken by temperatures above 12 degrees Celsius. The bulbs of the chosen variety are transplanted at the start of the next spring, leaving a gap of 20 cm between them and not burying them too deeply.

One to three flower stems will emerge, each reaching a height of about one meter or more. They must be supported by a guardian in order to avoid falling. The onion umbel's single flowers are open for four weeks. As a result, the overall time from blossoming to seed maturity is extremely long. When the capsules formed from the blooms dry up and drop the black seeds when opened, you'll know the seeds are mature. Cut the umbels with a piece of stem to gather the seeds, then lay them in a cloth bag and dry in a warm, aired area.

To avoid seeds from dropping to the ground due to the effects of rain and wind in cold and humid climates, the seeds can be collected at maturation and the plant allowed to mature dry.

2.3 Foraging and pollination

https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.656.668&rep=rep1&type=pdf

Apis mellifera adansonii (Hymenoptera: Apodae) feeding and pollination activities on the fruit and seed of *Allium cepa* were studied in Maroua from November 2010 to April 2011.

All visitors had unlimited floral access, bagged flowers were used to avoid all visits, and A. m. adansonii visits were limited. A total of 120 blooms were seen in each treatment. Four days every month, between 07.00 and 18.00 h, flowers of Al. cepa were prospected for nectar and/or pollen foraging behavior of each pollinator. (Tchindebe & Fohouo, n.d.)

The seasonal rhythm of activity of the bees, as well as its pollination efficiency, fruiting rate, number of seeds per fruit, and percentage of seeds well developed, were all documented. The results demonstrate that honey bees forage for nectar virtually continuously throughout the day, with a peak between 8 and 9 a.m. (Tchindebe & Fohouo, n.d.) The rate of floral foraging was 47.12 7.19 blooms per minute. On the blooms of Al. cepa, individuals from 22 bug species were recorded. The most common species was A. m. adansonii, which received 40.62 percent and 51.48 percent of visits in 2010 and 2011, respectively.(Tchindebe & Fohouo, n.d.)

2.4 Pollination and potential pollinators

Onion inflorescence is an umbel made up of miniature hermaphrodite blooms that are independently self-sterile, meaning they require insect activity to fertilize each other. They have allogamous relationships. As a result of pest movement, there is a danger of cross-pollination between different varieties.

Two onion types should not be grown closer than 1 kilometer apart to prevent cross breeding.If there is a natural barrier between them, such as a huge hedge or a row of trees, the distance can be shortened to 200 meters. (*¿Cómo Producir Las Semillas de Cebolla? | ¡SIEMBRA!*, 2019) Mosquito nets open alternately or a fixed mosquito net with insect hives can also be used for varietal isolation. This technique is demonstrated in the 'ABCs of seed production' module on mechanical isolation.

In the Tizi Ouzou region, foraging insects of *Allium cepa* L. (Liliaceae) were researched throughout two flowering cycles in 2016 and 2017. (northeastern Algeria). Our initial observations revealed that Hymenoptera Apoidea is the most common forager insect that led and preferred this plant for foraging activity. The Apidae, Apis mellifera, and the Halictidae, Lasioglossum malachurum, and L. pauxillum, are the most common visitors on onion blooms, according to our findings. (*Foraging Bees of the Onion (Allium Cepa L.) and Their Impact on Seed Production in Tizi-Ouzou Area (Algeria)*, 2018)

Regardless of the product gathered, all of these species undertake good foraging. Furthermore, in terms of food research, our findings revealed a unique behavior of the honey bee, which focuses its trips solely on nectar gathering, whereas the visits of two other species are considerably more mixed. We confirm that the presence of pollinating insects considerably contributes to the improvement of production; in fact, the grain yield acquired by cross-pollination is larger than gained by autogamy, according to prior research on *Allium cepa* L. (Liliaceae). We discovered that the average weight of seeds obtained per free quadrate is 4.14 g, while the average weight of seeds obtained per caged quadrate is 0.09 g.

2.5 Sexuality

Whereas many of these plantlets are essentially miniature versions of the mature plants, other asexual propagules are formed from small, less defined structures called bulbils. The most notable of these occur in the families Poaceae (Youngner 1960; Steiner et al. 2012), Liliaceae (Gagea; Arber 1925; Schnittler et al. 2009), Dioscoraceae (Walick et al. 2010), and Amaryllidaceae, including members of the genus Allium L. such as Allium sativum L. (garlic), Allium ampeloprasum L. (Leek), Allium canadense L., Allium geyeri var. tenerum M. E. Jones, Allium vineale L., and *Allium cepa* var. proliferum (Moench) Schrad. ex Willd. (Egyptian walking onion, or tree onion; Arber 1925; Bengtsson and Ceplitis 2000; Ceplitis 2001; Wheeler 2011; Wheeler et al. 2013). In these plants, the inflorescence may be made up of completely flowers, only bulbils, or (in some cases) both. Flowers may contain viable pollen, seeds, and/or both or, on occasion, are completely sterile.

In addition to the significance of bulbils and flowers denoting a complex reproductive strategy is the presence of an associated bulb covered with monocot-like leaf bases with parallel veins and producing several roots, which we suggest belongs to the same plant. Whereas bulbs are commonly known to us because of their association with economically important food plants (e.g., onions) and horticultural varieties (e.g., lilies), they are quite limited in their taxonomic distribution to only a small number of monocot groups (Dahlgren and Clifford 1982). Whereas stems are modified commonly for storage as corms and underground rhizomes, the modification of leaves as part of an underground shoot system (i.e., a bulb) appears to be limited to a much smaller group of monocots.

2.6 Year to year variation in flowering

Flowering-related genes affect onion bulbing and are an essential agricultural feature that affects economic value. The functioning of the Blooming LOCUS T (FT)-like gene is required for the commencement of flowering in a variety of plant species, as well as asexual reproduction in tuber plants. We found eight FT-like genes (AcFT) expressing PEBP (phosphatidylethanolamine-binding protein) domains in Allium cepa using various computational analyses based on RNA-Seq data. (Manoharan et al., 2016) Six proteins were found to be identical to previously known AcFT1-6 proteins, such as one (AcFT7) with a conserved area associated with AcFT6 and another (comp106231) with little resemblance to MFT protein but including a PEBP domain. With change in the C-terminal region, homology modeling of AcFT7 proteins revealed similar architectures and preservation of amino acids essential for functionality in AtFT (Arabidopsis) and Hd3a (rice).

They also looked at AcFT expression patterns in two genotypic lines, EM (early maturation, 36101) and LM (late maturation, 36101), at distinct transitional periods, as well as under SD (short-day), LD (long-day), and drought treatment (late maturation, 36122). Various environmental conditions, including as photoperiod, temperature, and dryness, had a significant impact on the amounts of FT transcripts. Our findings imply that AcFT7 is a member of the FT-like genes in Allium cepa and, like other FT genes, may be involved in onion bulbing control. Furthermore, AcFT4 and AcFT7 may be implicated in determining the difference in bulb maturity time between the two onion lines. (Manoharan et al., 2016)

2.7 Root system

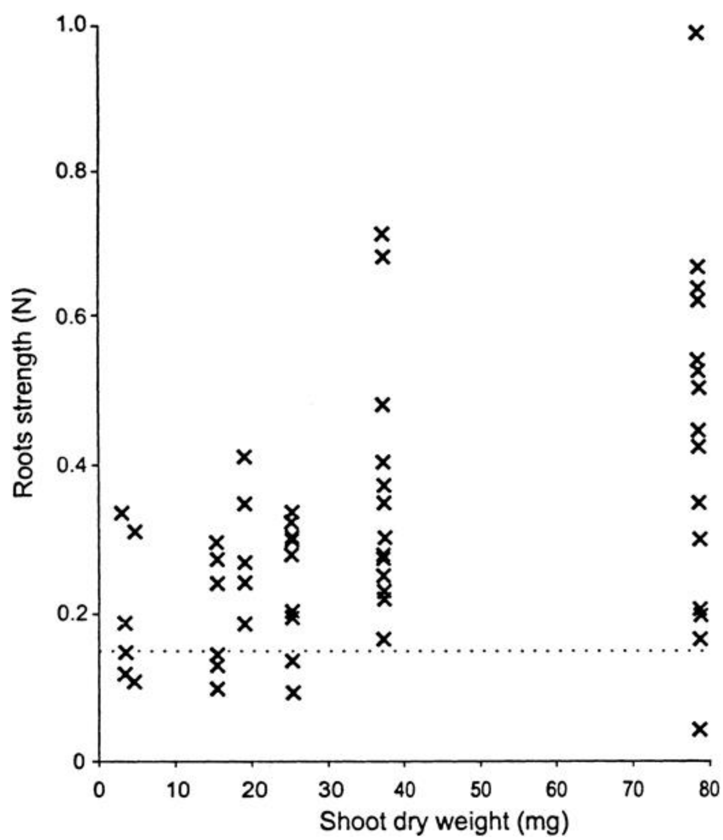
The onion, Allium cepa, was studied and found to have a very basic root structure. Individual onion roots' maximum strength rose as the plant grew older. Resistance to uprooting in onion seedlings might be broken down into a sequence of events linked to the destruction of individual roots in uprooting tests. In a regression model, peak pulling resistance was described by a combination of a measure of plant size and the amount to which individual root uprooting resistance was additive. Root cooperation is the word for this cumulative effect. The function of root cooperation in uprooting resistance is demonstrated using a simple model.

2.7.1 Individual root strengths

Individual adventitious roots growing from the stem base were plucked and tested after the plants were thoroughly cleaned out of the soil. Each root was trimmed down to its basal (nearest the shoot) 40 mm length. Between 0.1 mm thick steel plates, 10 mm was bonded at either end (Loctite Superattak, a cyanoacrylate adhesive). A 20 mm center portion was left, which was tested in a universal testing machine at a deformation rate of 20 mm min1, imposing an initial strain rate of around 0.017 s1. If the root was longer than 80 mm, a second 40 mm sample was collected from the basal end. The samples were allowed to dry for around 30 minutes throughout the preparation to allow the adhesive to adhere correctly. The roots were soaked in tap water for 5 minutes right before the test. This would have allowed for full turgor recovery. Because roots are subjected to drying on occasion, it was determined that this consistent treatment was not significantly different from what would occur in nature. The breaking force as well as the break's location were noted.

The majority of the roots (83/93) failed at or around the clamp. This was at the lower clamp in 75% of the instances (63/83). This is a very substantial bias (P0.001) (2=22.3). Roots tended to break towards the bottom clamp because, as previously noted, roots grew weaker as they got further away from the stem (Easson et al., 1995). A load of some of the fractures near clamps, on the other hand, would have been lowered by the local increase in stress caused by the clamps. For all of the roots, the amount of this effect is likely to be identical. The goal of this experiment was to measure the strength of individual roots and see if they changed considerably across plants of different sizes. The findings enabled the scientists to choose a load decrease in uprooting studies that indicated a fractured root (0.15 N, see next section), which was common to all plant ages. The first 40 mm sample was significantly stronger than the second (paired test, t39=5.27, P0.001, mean difference 0.12 N). There was no relationship between the length of the root and the strength of the basal 40 mm. (Bailey et al., 2002) Although the maximum strength of root samples (basal 40 mm) increased with shoot dry weight, the strength of the weakest root samples did not, resulting in a very large variance in the strengths of roots from large plants.

Fig. 10: *Allium cepa* cv. White Lisbon. Individual root strength for basal 40 mm samples plotted against shoot dry weight. The horizontal dotted line is at 0.15 N.



2.8 Pests and diseases

In the 2014- 2015 cropping season, there was a study done on major onion diseases and insect pests conducted in Masha District of Sheka Zone. The aim of the study was to determine occurrences and assess the impacts of major diseases and insect-pests of onion. During the crop's growth seasons, field inspections were conducted at 1 to 2 km intervals. Field data was taken at each 5 m interval in each sample, and a quadrate (1 m 1 m) was tossed in a diagonal pattern in the field. In the the studied region, a variety of illnesses and insect pests were documented and identified. During the surveying period, certain pests were discovered to be important and others to be small. The most common onion diseases were purple blotch, downy mildew, damping-off, and iris yellow spot virus. Thrips, cutworms, and caterpillars were the most common insect pests. Most farmers, on the other hand, lacked knowledge about pest management, pesticide usage and safety, and insect and disease identification. Creating awareness and implementing integrated pest management might be a top goal for controlling the program. In general, the findings suggest that illnesses and insect pests identified as serious pests demand immediate research and development activities. In addition, a regular monitoring plan must be developed; in the meantime, one little bug at a time becomes a significant problem.

Powdery mildew and purple blotch are the most common onion diseases in the Masha district, infecting the plant during the bulb initiation stage. The infestation was severe in all of the studied kebeles, with an intensity of more than 25% in all of the regions tested. Both main onion and shallot infections were also documented in Ethiopia by Bekele (1985). (Haile, 2019) One of the biggest obstacles to onion output was damping off. In the studied locations, disease severity was greater than 25% at the seedling stage.

Fig 11: Status and distribution of onion diseases in Masha area.

Disease	Scientific name	Pathogen	Growth stage	Intensity	Kebele
Purple blotch	Alternaria parii	Fungus	Bulb initiation stage	XXX	Y, S, G
Downy mildew	Peronospora distructor	Fungus	Bulb initiation stage	XXX	Y, S, G
Bulb rot	Fusarium spp	Fungus	Maturity	X	Y, S, G
White rot	Sclerotium cepivorum	Fungus	Maturity	X	Y, S, G
Damping off	Fusarium spp.	Fungus	Seed/Seedling stage	XXX	Y, S, G
Iris Yellow Spot Virus	Tospo virus	Virus and Thrips vector	Vegetative stage	XX	Y, S, G

When <5 of plant infested (X), 5 to 25% of plant infested (XX), >25% of plants infested (xxx), Yina (Y), Shibo (S), Gatimo (G).

2.9 Anthesis

The requirement for insect pollination is determined by the flower's form, degree of self-fertility, and bloom arrangement. The frequency of Apis mellifera L. visits, the anthesis stage, and pollen viability were all measured in a research on the course of Allium cepa L. flowering. The Crioula cultivar has a longer flowering time (56 days) than Bola Precoce (50 days). Both cultivars had a similar blooming peak length of 15 and 17 days, respectively. The relationship of A.'s frequency of visits and the frequency of A.'s visits. In Crioula, the quantity of umbels with open flowers was high, whereas in Bola Precoce, it was ordinary. In the two cultivars, anthesis occurred at 7 and 8 days, respectively (Witter et al., 2005). Incomplete protandry has been confirmed in both cultivars, contrary to previous reports. When the styles reached a length of 4–5.5 mm, the stigmas became receptive. The average pollen viability percentage was 90.46 (Crioula) and 80.25 (Crioula) (Bola Precoce).

The study took place in the Municipality of Candiota, RS, Brazil, between October and December 1999 and 2000, in two harvests for the production of onion seeds, each with an area of roughly 2.5 ha, and employed as part of the Hortec Sementes Ltda's production program. Your position is between 30030' S and 31056' S latitude and 55030' W and 54030' W longitude (Macedo 1984).

The region's climate is mesothermic and subtropical, with rain falling throughout the year. The average yearly temperature is 17.6 degrees Celsius, with relative humidity ranging between 75 and 85 percent (Macedo 1984). The soil is Podzolic red-yellow in color.

2.10 Ecophysiology

Experiments using attached and detached epidermis of Allium cepa and Asphodelus tenuifolius were conducted to determine the influence of various ecological circumstances and the role of incubation media. Both of these species had chloroplasts in their guard cells. As in whole plants, the stomata continue to respond to environmental influences. In the winter, the stomata remained open all day, whereas in the summer, they only displayed a minor closing. The acidity or alkalinity of the medium had no influence on the stomata's opening. The type of the incubation medium was discovered to have a significant impact on stomatal pore control, with solutions with comparable osmotic potentials but differing ions behaving differently. (Sen

& Harsha, 1974) Sucrose solutions had little effect, while potassium ions appeared to have a direct role in stomatal opening. When incubated in potassium chloride solution, uptake of neutral red revealed that A. tenuifolius had a significantly higher absorptive capacity than A. cepa, and so the results of the two species differ.

3.0 Propagation and Management

3.1 In vitro Regeneration

There was a study done by the Biology Department of the college of Natural and Computational Sciences (CNCS), Haramaya University. With the purpose of developing an efficient protocol for in vitro regeneration of shallot (Allium cepa). For this, two local shallot varieties (Huruta and Minjar) were used as experimental materials where basal discs were used as explants. Murashige and Skoog medium supplemented with different concentrations and combinations of 2, 4-Dichlorophenoxyacetic Acid, 6-Benzylaminopurine, Kinetin and α-naphthaleneacetic acid were used for callus induction and regeneration of plantlet. In medium treated with 1mg/l 2, 4- Dichlorophenoxyacetic Acid, genotype Huruta showed the most callus induction (81.11 percent). Huruta and Minjar genotypes demonstrated the maximum callus induction (74.44 percent) from basal discs implanted in media supplemented with 1 mg/1 2,4-Dichlorophenoxyacetic Acid in a combined effect. The greatest callus fresh weight of 1.26 and 1.20 g were attained with 1 mg/l 2, 4- Dichlorophenoxyacetic Acid and -naphthaleneacetic acid paired with 1 mg/l 6-Benzylaminopurine, respectively, among the various types and combinations of plant growth regulators. Somatic embryogenesis and organogenesis were used to create regenerated plants. Shoot regeneration was greater in Murashige and Skoog media supplemented with 5.0 mg/l 6-Benzylaminopurine + 0.1 mg/l -naphthaleneacetic acid (91.11 percent). The optimal concentration was 1.5 mg/l indole-3-butyric acid + 2 mg/l 6-Benzylaminopurine, which yielded 86.66 percent of the results. (Haile et al., 2013)

Shoot regeneration was higher (91.11 percent) in Murashige and Skoog media supplemented with 5.0 mg/l 6-Benzylaminopurine + 0.1 mg/l-naphthaleneacetic acid. The optimal concentration was 1.5 mg/l indole-3-butyric acid + 2 mg/l 6-Benzylaminopurine, which produced 86.66 percent rooted plantlets. For Minjar and Huruta, the survival percentage of transplanted regenerated plantlets was 66.6 percent and 60.0 percent, respectively. (Haile et al., 2013)

For clonal replication of onions, in vitro plant development by direct organogenesis from immature flower heads is an appropriate method (Allium cepa L.). With an advantage over other methods of in vitro regeneration, this procedure provides genetic stability, a high replication rate, and keeps the donor plant of explants alive. Onion micropropagation is commonly used in breeding programs, the maintenance and multiplication of cytoplasmic-male sterile lines for hybrid creation, germplasm conservation, and the use of other biotechnologies, as well as in germplasm conservation. In order to cultivate mature onion bulbs in vitro, vernalization is used to initiate the reproductive phase and drive inflorescence start. When immature umbels emerge from the pseudostem among the leaves, they are detached from bulbs or cut immediately. Disinfected inflorescences are grown for 35 days in BDS basal medium with 30 g/L sucrose, 0.1 mg/L naphthalene acetic acid, 1 mg/L N 6-benzyladenine, and 8 g/L agar, pH 5.5, under 16 h photoperiod white fluorescent light (PPD: 50–70 mol/m2s)(Marinangeli, 2013).When immature umbels emerge from the pseudostem among the leaves, they are detached from bulbs or cut immediately. Disinfected inflorescences are grown for 35 days in BDS basal medium with 30 g/L sucrose, 0.1 mg/L naphthalene acetic acid, 1 mg/L N 6-benzyladenine, and 8 g/L agar, pH 5.5, under 16 h photoperiod white fluorescent light (PPD: 50–70 mol/m2s)(Marinangeli, 2013).

3.2 Propagation

When the majority of plants in an accession have mature seeds, harvesting is done manually. Harvesting is done in stages if there is significant variability in seed ripening between plants in one sample. Plants are staked to avoid lodging. The entire inflorescence is gathered and placed in marked paper bags before being transported to the oasthouse to be dried and cleaned.

Onion has a bulb, which is a form of subterranean stem alteration. It's shaped like a pear and is underground. The terminal bulb and a disc-shaped stem are surrounded by many fleshy scales. Adventitious roots emerge from the bulb's base. It is non-green, with food storage and perennation as its primary functions.

Vegetative propagation is advantageous since the genetic configuration is preserved, but it also has a disadvantage. It hinders new variations and superior offspring by preventing genetic variety in organisms. Low production might result from a similar genetic makeup, which is bad for the crop's health and economy.

The bulb is the vegetative propagation unit for plants, including onions, garlic, tulips, daffodils, and hyacinths. The stem is reduced to a disc, commonly referred to as the basal plate, from which roots sprout around the perimeter. The leaf bases are linked to the stem's top surface. In later years, the axillary buds located at the node (where the leaves attach) might grow into new bulbs. Thus, if you plant one daffodil bulb, you will have numerous bulbs in that location fighting for nutrients, water, and light exposure a few years later. Unless the gardener digs up the competing bulbs and divides them in late summer, blooming may be diminished over time. When you peek inside an onion, you may find that it has "two" bulbs.

3.3 Vegetation propagation

New plants can be produced from vegetative structures such as the roots, stems, and leaves of some plants. The process can be natural or artificial.

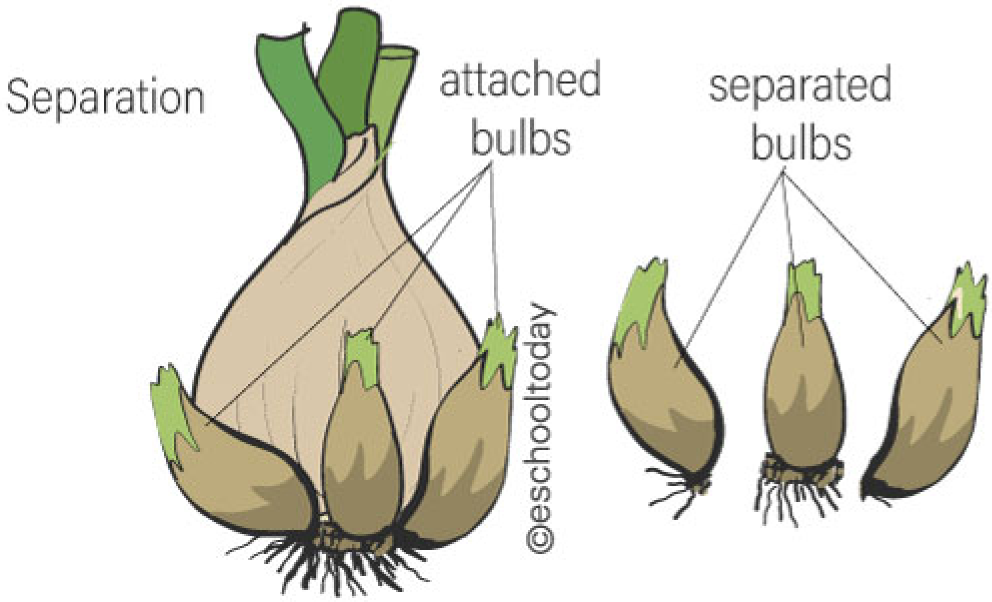
Onion stems are used for vegetative growth. Onion bulbs contain thick, short stems in the shape of a condensed disc, according to the activity of producing onions through vegetative propagation. Terminal and axillary buds grow on the disc. New green aerial shoots emerge from the axillary buds.

Onions may be produced from bulbs by vegetative propagation. The bulb develops through the formation of the radicle and flag leaves, followed by the appearance of genuine leaves. Self-propagation is an asexual reproductive mechanism that occurs naturally. Onions produce buds on the surface of the stem that they develop from.

In the Northern Hemisphere, the genus Allium L. has over 500 species, many of which are beneficial plants. Rhizomes and bulbs, the extremely varied subterranean organs of Allium species, have the role of storing food and moisture in harsh weather circumstances. Their second crucial role, vegetative reproduction, and propagation, boosts the odds of survival and helps natural populations maintain genetic stability. There are five distinct kinds of vegetative reproduction and propagation among the approximately 40 species analyzed. Apical buds, daughter bulblets, stolons, and apomictic bulblets have all been detected in the inflorescense. It's possible that vegetative propagation, morphological type, and life cycle all have something in common. The development of the genus and species' migration to dry environments may have resulted in the phylogenesis of a preference for seminal reproduction over vegetative propagation.

Vegetative plant structures are produced by some plants for two main reasons: vegetative propagation and food storage. Bulbs, corms, rhizomes, suckers, and tubers are examples of vegetative structures. Two methods of obtaining branches from the parent plant might be utilized in all of the vegetative structures mentioned above. They are Separation and Division, respectively. It's critical to utilize the correct terminology while describing the procedure. The young branch is simply separated (detached) from the parent for planting. (*What Is Separation and Division in Vegetative Propagation?*, 2021) This method may be used to separate daffodil, tulip, and lily bulbs. Some bulbs generate bulblets, which are miniature bulbs that adhere to the parent bulb's base. For propagation, they can also be separated. Separation of cormels (baby corms attached to the parent corm) is also possible for propagation.

Figure 12:



3.4 Planting

During the years 2004-05 and 2005-06, the effect of three planting densities (20, 30 and 40 plants/m2) on bulb yield and yield-related traits of five onion cultivars (Naurang Local, Panyalla Local, Phulkara, Shah Alam Local, and Swat-I) was studied in the Department of Horticulture, Gomal University, D.I.Khan, Pakistan. The findings demonstrated that planting densities had a considerable impact on onion bulb production and yield contributing characteristics. In a sparsely populated crop (20 plants/m2), the maximum number of leaves, leaf length, bulb diameter, and average bulb weight were observed. During both years, the maximum bulb output was attained in medium populated crops (30 plants/m2), followed by thinly (20 plants/m2) and thickly (40 plants/m2). (*EBSCOhost | 54846672 | PLANTING DENSITIES EFFECT on YIELD and YIELD COMPONENTS of ONION (ALLIUM CEPA L.).*,

2022) The number of leaves, leaf length, bulb diameter, bulb weight, and bulb production differed greatly among cultivars. In different metrics, Shah Alam Local outperformed all cultivars, followed by Naurang Local, Panyalla Local, and Swat-I.

Early and later ripening cultivars of spring and autumn-seeded onions were sown at 25, 100, and 400 plants per m2 on two occasions. Nutrients at high concentrations and irrigation were used. High plant density and early seeding both accelerated the initiation of bulb scales, rather than leaf blades, at the shoot apex, and hence the date of maturity by up to 46 days. The later mature spring-sown cultivars responded better to density and sowing date than the earlier maturing spring-sown cultivars, which were more responsive than the autumn-sown cultivars. (MONDAL et al., 1986) Maturity dates rose linearly as the fraction of energy intercepted by the leaf canopy decreased for each cultivar.

Onions have been used as a food crop by humans for millennia. Onions have been cultivated for more than 4,000 years, long before written history began. Onions are thought to be native to Asia or the Mediterranean, although they've been utilized in Chinese and Indian cuisine for centuries. Onions have always been regarded as more than just a food source by humans.

Onions are classified as short day, long day, or day neutral according on how many hours of sunshine they require to bulb. It makes no difference for day neutral onions. To develop bulbs, long day onions require 14 or 15 hours of sunlight, whereas short day onions require just 10 hours. Green onions, on the other hand, are grown not for their bulbs but for the tall, green tops that grow above the ground, which require just six hours of daylight to flourish. (*How to Grow Green Onions (Allium Cepa) - Gardening Channel*, 2020)

Green onions require a soil that drains rapidly and won't retain too much water when it rains, even if the weather is chilly, because they thrive in temperatures between 68 and 77 degrees. Mix two or three inches of well-rotted compost into your soil before planting green onions to enhance the soil.

Green onions require a soil that drains rapidly and won't retain too much water when it rains, even if the weather is chilly, because they thrive in temperatures between 68 and 77 degrees. Mix two or three inches of well-rotted compost into your soil before planting green onions to enhance the soil. It's ideal to use crop rotation and plant your green onions in a plot that hasn't seen any alliums in at least three years. This will help to prevent many of the soil-borne illnesses that might afflict allium crops.

3.5 Management

Dry bulb onions and leeks, at the marketable stage of development, were dissected into nine and ten fractions, respectively, comprising the stem and leaves in succession from the oldest outer layers. Each fraction was separately analyzed for flavor components by the determination of thiosulphate and pyruvate. The dried outer scales were virtually free from flavor components, the concentrations of which (on a fresh weight basis) increased progressively from a minimum value in the outer leaf to the innermost tissue and the stem.

The latter often contained more than twice the concentration present in the outer leaf. The pattern in the roots and edible portions of leek differed in detail from that in onion. Flavor intensity increased progressively from the outer leaf to the inner tissues and the concentrations in both the roots and the stem were approximately equivalent to that of the fourth leaf numbered from the outer leaf. Some aspects of knowledge of the metabolism of inorganic nitrogen and sulfur compounds in roots and other tissues and transport of the corresponding metabolites have been briefly reviewed as the basis of a preliminary interpretation of the above observations. Attention has been drawn to the bearing of the results on the preparation of onions for cooking and processing and on sampling for analysis.

In two consecutive kharif seasons of 2010 and 2011, an integrated weed management study on onion (Allium cepa L.) was conducted in a randomized block design with nine treatments, including hand weeding with application of pendimethalin 1.0 kg/ha pre-plant incorporation (PPI) and oxyfluorfen 0.250 kg/ha post-emergence (PoE). Weed control with three hand weedings (HW) at 20, 40, and 60 days after transplanting resulted in significantly lower weed density, dry weight of weeds, and higher weed control efficiency, as well as the highest levels of all onion growth and yield attributes, including plant height, neck thickness, bulb weight, bulb diameter, and bulb yield. (Kalhapure, A.H.;Shete, B.T.;Bodake, P.S, 2014) The application of pendimethalin 1.0 kg/ha (PPI) + oxyfluorfen 0.250 kg/ha (PoE) + One hand wedding at 40 DAT, which was determined to be the most practicable and economically feasible weed management approach in onion, yielded the highest net monetary returns (110.3 103/ha) and B:C ratio (2.76).

An experiment was carried out to see how weed control and plant feeding techniques affected weed biomass, growth characteristics, and onion bulb production (Allium cepa L.). Weed control methods included using herbicides alone, such as pendimethalin, oxyfluorfen, and fluazipop-p-butyl, or combining them with manual weeding, weed free, and weedy check. RDF

(100:50:50 NPK kg/ha), RDF (100:50:50 NPK kg/ha), and 125 percent RDF were used to fertilize the crop. Weed control and fertilizer levels had a substantial impact on weed population dynamics and onion bulb crop yield, according to the findings. During all seasons of the study, the application of pendimethalin 1 kg/ha or oxyfluorfen 0.24 kg/ha + one hand weeding at 40 days after transplanting (DAT) significantly reduced total weed density. Digera arvensis Forsk., Echinochloa ssp., Trianthema portulacastrum, Echinochloa ssp. The dominant weeds in the crop were Physalis minima L. and Cynodon dactylon (L.) Pers. Pendimethalin 1 kg/ha + one hand weeding at 40 DAT resulted in a higher onion bulb output (38.0 t/ha).(Patel et al., 2012) When compared to the yield obtained in weedy check, the increase in yield was 83.7 percent. The total biomass of grassy and broad-leaved weeds grew as the amount of fertilizer applied increased. The use of 125 percent RDF considerably increased bulb production, with increases of 19.4 and 10.5 percent above 75 percent RDF and RDF, respectively. (Patel et al., 2012) The combination of pendimethalin 1 kg/ha fb 1 hand weeding at 40 DAT and 100 percent RDF was the most productive (39.8 t/ha) and profitable (Net return 2,69,422/ha and benefit 2,69,422/ha) on the basis of interaction.

3.6 Fruiting

Display/Harvest Time: Summer. Fruit Type:Capsule. Fruit Description:Flowers wither and convert to bulblets. Flower Color: White. Flower Inflorescence: Umbel. Flower Bloom Time: Summer. Flower Shape: Bell. Star Flower Petals: 6 petals/rays. Flower Description: Small clusters of white or pink star or bell-shaped flowers with exerted stamens.

3.7 Vegetation Components

Vegetative Components of Onion (Allium cepa L.) as Influenced by Nitrogen, Phosphorus and Locations During the 2003/2004 dry season, field trials were undertaken in two distinct locations (Bauchi and Kardam) employing nitrogen (N) (0, 55, 110, and 165 kg ha-1) and phosphorus (P_2O_5) (0, 45, 90, and 135 kg ha-1) rates. Treatments were blended and organized in a randomized full block pattern with three replications in each site. The results demonstrated that nitrogen (N), phosphorus (P_2O_5), and location all impacted onion vegetative components. Plant height and number of leaves increased in a significant and gradual manner as N and P2O5 rates increased. Only N enhanced onion vegetative output considerably. Only the interactive impact of nitrogen and location was significant at the 5% level among all the interactions seen in onion plant height, number of leaves, and vegetative output. Plants height and number of leaves, irrespective of N-rates, increased significantly and considerably in Kardam flooded valley when 165kg ha-1was applied. This trend was further recorded in vegetative yield at Bauchi.It was therefore concluded that, as much as 165 kg Nha-1 and 135 kg P2O5 ha-1 are needed to increase yield in onion vegetative components in Bauchifadama areas as well as Kardam flooded valley and their related ecologies. (Ishaku James Dantata, 2013)

3.8 Harvest

Green onions can be harvested 40 to 50 days after seeding or 30 days after transplanting sets or transplants into the garden. They're ready when the tops have reached six inches in height and are the size of a pencil. Green onions have a richer flavor as they become older and bigger. You can always cook with them if they become too strong to consume raw. Harvest them by gently lifting them up.

4.0 Allium cepa Value Chain and Applications

4.1 Imports

In Colombia Onion farming is the economic backbone of Cucaita, and it is centered in the valley. However, as yields drop due to soil deterioration, agriculture is spreading to the slopes, where unsustainability is more evident. The goal of this study was to test the viability of three sustainable farming options on two farms utilizing a split plot design. The alternatives were… 1) bocashi chicken manure, super broth four, fertilizer (BCmSB4F), 2) bocashi cow manure, rhizosphere broth, super broth four, fertilizer (BCmRBSB4F), 3) green manure, rhizosphere broth, super broth four, fertilizer (Gm- RBSB4F), and 4) regional control were the options (RC). The incidence of illness, plant height, stem and bulb diameter, healthy and diseased bulb weight and yield were all determined in this study. The findings revealed that, regardless of the option, the farm's agro-ecological conditions are crucial to plant health and, as a result, crop output. The highest results for healthy bulb weight, bulb width, and yield were found in El Arenal, where illness prevalence was lowest. Only at 30 and 45 days after transplant did the alternatives differ in illness incidence, with the green manure alternative having the lowest percentages. The three options were advantageous in terms of revenue, particularly the BCmRBSB4F option, which outperformed the RC. The results reveal that the GmRBSB4F and BCmRBSB4F options have the most potential and are the most feasible for long-term onion production in Cucaita, Boyaca.

Since 1986, the Natural Resources Institute in the United Kingdom has conducted a questionnaire survey on onions and shallots (A.cepa) growing in the tropics. In NRI Bulletin 35, the findings of the first 72 responses are released. "Onions in Tropical Climates" is a book on onions grown in tropical climates. The survey discovered that there is still a large range of local land-races and onion choices in the Old World tropics. Many varieties of bulb onions, as well as A.cepa variations such mmultiplier onions and shalltos, are produced in India and the adjacent nations of South Asia. Shallots and multiplier onions are presently far more often grown than bulb onions in lowland tropical nations like Indonesia and Sri Lanka. Breeding and selection are going on right now. (Currah & Proctor, 2019) Local onion land-races are also found in West and East Central Africa: in West Africa, they are mostly red and white, whereas in Sudan, there are red, white, and yellow onion races. Shalltos are cultivated in numerous tropical African nations, including on the coasts of Ohana and Togo, as well as in the Ethlopla highlands. Seed companies in the United States are increasingly using land-races from the Mexican highlands in their breeding programs. Many Central American countries rely heavily on onion seed imports from the United States, and they often cultivate onions of the variety "Texas 1:arly Grano" and its variations. The Caribbean islands, as well as Guyana, cultivate red shallots. The 'Creole' onions are a kind of onion from the southern United States that is commonly utilized in the tropics. Multiplier onions are native to Colombia and Ecuador, but imported bulb onion varieties are becoming increasingly popular. Short-day onions are cultivated in Amazonia and the Northeast, 'Granex' hybrids and local selections in the Sao Paulo region, and selections originating from the 'Baia Periofrme' type in the south of the country: onion breeding is active. Local brown and white onion choices have been established in Queensland, Australia.

Light brown onions from the Cape area have been chosen or changed by cross-pollination with American material in southern Africa, and a variety of short-day suited open-pollinated cultivars from the Transvaal are commonly produced in Zimbabwe. (Currah & Proctor, 2019) Zambia and Malawi, as well as newer short-day hybrids in the United States. Several seed companies in Europe, the United States, and Israel are focusing on developing tropical onion cultivars. Because their adaptive properties, such as disease and pest resistance qualities, are just now being examined. It is critical to maintain the genetic resources of the indigenously chosen tropical onions. [AS]

According to FAO figures, continental China produced 15 million t of dried onion bulbs in 2001, India produced 5 million t, and the United States produced more than 3 million t; Brazil, Indonesia, Iran, Japan, South Korea, Pakistan, Russia, Spain, and Turkey each produced more than 1 million t. The Netherlands, for example, is a major exporter to Africa, generating more than 500,000 t for a very tiny population. Shallots are either mixed with green onions or included in bulb onion statistics. In the latter category, Mexico reported a production of over 1 million t. Some of these data, however, should be viewed with caution, particularly in Asian nations where 'onions' may comprise Allium fistulosum L. Furthermore, data for tropical nations is sometimes incomplete. Tropical Africa produces 1.5 million t of sugar, compared to 2.2 million t in non-tropical Africa. It's impossible to tell if these 'dry onions' are completely seed-propagated or include shallots. Most tropical African nations purchase onion bulbs from Niger, which exports a large portion of its 200,000 t production, as well as Europe and South Africa. Shallots are sold to neighboring nations from northern Côte d'Ivoire and Mali. (*Allium Cepa L*, 2022)

4.2 Exports

The onion is a popular vegetable crop that is cultivated and consumed all over the world. It's a culinary element that enhances the taste and flavor of a variety of dishes, and it's also used in salads. With an area of 12.03 million hectares and a production of 19. 401 million tonnes, India is the world's second-largest producer (nhb., 2017). China and India, among the top ten countries (mostly Asian countries), account for more than 60% of world output. Turkey had the greatest onion yields (30.3 MT/ha), with Brazil (23.1 MT/ha), China (22 MT/ha), and India (16.10 MT/ha) following closely behind. Despite having the greatest onion-growing area, India ranks second in world onion output due to lower yields. (Srikanth, 2020) As a result, there is a lot of opportunity for raising onion output through increasing yields. India is also the world's largest exporter of onion, therefore it's critical to promote sound agricultural practices and quality yields in order to increase exports and assist the country's exchequer gain foreign currency.

Figure 13: Major onion producing countries in the world (Akinik Publications, 2020)

Country	Area (ha)	Production (MT)	Productivity MT/HA
China	1025000	22600000	22.0
India	1203565	19401677	16.1
United States of America	60000	3277460	54.6
Iran	71000	2260000	31.8
Russian Federation	92100	2080814	22.6
Egypt	60000	2024881	33.7
Turkey	63000	1819000	28.9
Pakistan	129700	1692300	13.0
Brazil	60931	1519022	24.9
Netherlands	27235	1353000	49.7
Others	1656002	27916265	16.9
World + (Total)	4448533	85944419	19.3

Source: FAO Website -February 2016 for India Data - (Data for 2015-16) Department of Agriculture & Cooperation.

4.3 Consumption

The spice plant Allium cepa, also known as onion, is a member of the liliaceae family. It has been utilized for the treatment of a variety of ailments since ancient times. Among the many actions of Allium cepa, one of the most important effects in DM is the modulation of hypoglycemic activity. (Akash et al., 2014)Sulfur compounds, such as S-methylcysteine, and flavonoids, such as quercetin, are primarily responsible for Allium cepa's hypoglycemic action. S-methylcysteine and flavonoids reduce blood sugar, serum lipids, oxidative stress, and lipid peroxidation while also enhancing antioxidant enzyme activity and insulin secretion. By normalizing the activity of liver hexokinase, glucose 6-phosphatase, and HMG coenzyme-A reductase, onion extracts have been demonstrated to have hypoglycemic and hypolipidemic effects. (Akash et al., 2014) In preliminarily clinical trials, patients with diabetes safely consumed slices of Allium cepa, exhibiting sufficient hypoglycemic activity. In the future, further studies must be conducted to investigate and confirm the hypoglycemic activities of Allium cepa and its constituents and/or their synthetic analogs.

Although garlic and onions have long been linked to potential cardiovascular health benefits, the effects of various commercially available onions and intake levels have not been investigated. As a result, the current study used the pig as a biological model to assess the possible health advantages of raw onions. In a (2 x 2)+1 factorial experiment, twenty-five female (Large White x Landrace) pigs were employed.(Ostrowska et al., 2004) Pigs were fed a regular grower meal supplemented with 100 g tallow/kg, as well as 0, 10, or 25 g/MJ digestible energy from Allium cepa var. cavalier or var. destiny for 6 weeks. Overall, onions caused substantial decreases in plasma triacylglycerol; however, the reductions were greatest in pigs given raw onions (-26 percent, P=0.042). There were no significant differences in total plasma cholesterol or LDL:HDL ratios. (Ostrowska et al., 2004) In pigs fed onions, erythrocyte counts and hemoglobin levels were reduced in a dose-dependent manner, but white blood cell concentrations, notably lymphocytes, were enhanced. Furthermore, onion ingestion had little effect on blood coagulation parameters. To summarize, raw brown onion supplementation possesses mild lipid-modulating and immunostimulatory characteristics. However, a daily onion consumption of more than 25 g/MJ digestible energy may be harmful to erythrocyte counts.

4.4 Benefits and Uses

The common onion (Allium cepa L.) is one of the world's oldest cultivated plants, used as a vegetable and flavoring all over the world. Sulphur amino acids, as well as a variety of vitamins and minerals, have been found in this species. Flavonoids, phytosterols, and saponins are among the secondary metabolites that have been discovered. Despite its primary usage as a food source, this plant has been shown to provide a wide range of health benefits. A variety of biological activities have been described, including antioxidant, antibacterial, and antidiabetic effects. The goal of this review is to present an overview of the research on this species' favorable effects on obesity and its comorbidities, such as hyperlipidemia, hypertension, and diabetes. The effects of onion food supplementation in vitro and in vivo have been considered. Furthermore, the potential function of onion bioactive components in modifying or preventing weight gain or associated disorders, as well as the processes behind their action, is explored in this study.(Marrelli et al., 2018).

They can be eaten fresh, cut for salad flavoring, cooked with other vegetables, or fried with meat and other vegetables. In many African sauces and relishes, they are a must-have ingredient. They can be used as a condiment if ingested in modest amounts for their pungency. In the same way, the leaves, full immature plants (called'salad onions' or'spring onions'), or leafy sprouts from germinating bulbs (called 'cébettes' in southern France) are utilized. Immature flower heads are also a popular culinary item in the area. Leaves that are still green during bulb harvest are mashed and used to form sun-dried and fermented balls, which are subsequently used to season foods in regions of West Africa. Raw onions contain antibacterial capabilities, which can help prevent bacteria, protozoa, and helminths from infecting salads. Onions are used topically to cure boils, felons, wounds, and stings, and internally to treat coughs, bronchitis, asthma, gastro-intestinal diseases, and headaches in traditional medicine.

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