OliveCulture

Holistic and Multi-professional Mechanism for a Pakistani Olive Oil Value Chain

PAKISTAN:

SELECTION OF OLIVE CULTIVARS AND THEIR POTENTIAL BY PROVINCE

CIHEAM
BARI

AUTHORS:

Azmat Ali Awan, Deputy National Project Director POCCSP (II) (Pakistan)

Lorenzo Laghezza, Agronomist, Agrimeca Grape, and Fruit Consulting S.R.L.

Costantino Parma, Agronomist, Expert senior, CIHEAM Bari (Italy)

Marco Marchetti, Agronomist, International Coordinator of Project OliveCulture, CIHEAM Bari (Italy)

Muhammad Arabi Awan, Agronomist, OliveCulture, CIHEAM Bari (Italy)

ACKNOWLEDGEMENTS

The selection of olive cultivars and their potential by the Province is the result of the concerted efforts of the authors and the valuable support and encouragement from different institutions and colleagues, to whom we want to express our gratitude.

We would like to acknowledge the ***Ministry of National Food Security & Research of Govt. of Pakistan, and the Pakistan Oilseeds Department*** for their continuous support during the realization of the OliveCulture Project and their contribution during the work.

We are particularly grateful to the colleagues from the ***Italian Agency for Development Cooperation – AICS Office for Pakistan and Afghanistan,*** who are supporting the activities of the Project.

Special thanks are expressed to all ***farmers, technicians, and stakeholders of Balochistan, KP, and Punjab*** for their continuous involvement in the assessment and collection of morphological and phenological data that has led to this document.

Training and capacity building were an important part of this activity, and we wish to express our gratitude to **CIHEAM–Bari** for the training activities done in every corner of the olive growing areas from 2022 to 2024.

CONTACT DETAILS:

CENTRE FOR ADVANCED MEDITERRANEAN AGRONOMIC STUDIES MEDITERRANEAN AGRONOMIC INSTITUTE BARI (CIHEAM BARI)
Via Ceglie, 9 – 70010 Valenzano (BA), ITALY
Phone: +39 080 4606111 – Fax: +39 080 4606206
Email: iamdir@iamb.it – Website: www.iamb.it

MINISTRY OF NATIONAL FOOD SECURITY AND RESEARCH (MNFS&R),
Islamabad, Pakistan
Phone: – Fax: +92-51-9210616
Website: http://www.mnfsr.gov.pk/frmDetails.aspx

PAKISTAN OILSEED DEPARTMENT
Islamabad, PAKISTAN
Phone + 92 (0) 9216873-75
Email: info@POD.gov.pk
Website: https://pod.gov.pk/

ITALIAN AGENCY FOR DEVELOPMENT COOPERATION (AICS) in Islamabad
Islamabad, PAKISTAN
Phone: + 92 (0) 51.846.05.76
Email: segreteria.islamabad@aics.gov.it
Website 1: https://islamabad.aics.gov.it/

OLIVECULTURE PROJECT
Islamabad, PAKISTAN - House no. 12, Street no 56, Sector F-8/4
Email: oliveculture.ciheam@gmail.com
Website: http://oliveculture.org/

DISCLAIMER:

This publication has been produced in the framework of the Project "Holistic and Multi-professional Mechanism for a Pakistani Olive Oil Value Chain – Olive Culture", funded by the Italian Ministry of Foreign Affairs and International Cooperation and supervised by the Italian Agency for Development Cooperation, entrusted to CIHEAM – Bari and implemented in coordination with the Ministry of National Food Security and Research (MNFS&R) through the Pakistan Oilseed Department.

Published by:

CIHEAM – Bari

FOREWORD

The Italian Government's collaboration in boosting agricultural commodities, especially the olives sector, has always been at the pinnacle of mutual Pakistan-Italian cooperation for the last four decades when it comes to the value chain concept "from Farm to Fork", from providing nursery materials, exotic germplasm, and other particulars for the value chain, to delivering professional capacity building in the olive sector covering all aspects of this fruit plant.

Italian cooperation has always been extended to Pakistani scientists, stakeholders, entrepreneurs, and related arenas. It is with great pleasure and a sense of purpose that this varietal scheme was precisely documented to summarize the complex shades of olive varietal selection and cultivation in Pakistan. The varietal identification, characterization, and acclimatization in olive is perhaps the most difficult task when it comes to its cultivation in different areas of Pakistan.

As the cultivated olive is domesticated in Italy and neighboring the Mediterranean region, acclimatization of its varieties is a Hercules task. For this purpose, hundreds of adaptability trials and subsequent plantation of 5.7 million olive plants have been done across Pakistan, and after asserting the results of these plantations, the OliveCulture Project (Holistic and Multi-Professional Mechanism for a Pakistani Olive Oil Value Chain) under the esteemed supervision of experts from CIHEAM Bari (The Mediterranean Agronomic Institute of Bari Italy), a detailed varietal assessment with the zone of acclimatization has been documented to assist the current and future leader, stakeholders, entrepreneurs and farmers of Pakistan in its different provinces and region.

This publication represents a collaborative effort aimed at dividing the numerous climatic conditions widespread in Balochistan, Khyber Pakhtunkhwa (KP), and Punjab, and strategically aligning them with the suitable and acclimatized olive cultivars for each respective region. By outlining the climatic suitability of a selection of olive cultivars across these regions, the endeavor is to provide a comprehensive resource for farmers and stakeholders alike. This document is a detailed perspective of available olive germplasm in Pakistan along with varietal compatibility with the microclimate of different territories. The data collected is based on scientific notations and all other factors. More than 20 varieties of different exotic locations were cultivated and planted in all Pakistani provinces, however, the team of experts has selected 5 varieties concerning their suitability in each province based on observation, behavior, performance, oil percentage, and quality of extra virgin olive oil extracted. We hope that this book will not only help the farmers in the selection of varieties but will also determine the direction of future olive agronomic research in this context. By delineating the optimal olive cultivars for specific climatic conditions, this document aims to empower farmers, policymakers, and stakeholders with the knowledge and tools necessary to make informed decisions and drive sustainable agricultural practices. Our ultimate goal is to revolutionize olive cultivation in Pakistan by promoting the strategic planting of varieties tailored to thrive in their respective climates, thereby maximizing productivity and ensuring long-term sustainability.

Dr. Azmat Ali Awan
Dy. National Project Director,
Promotion of Olive Cultivation on a
Commercial Scale in Pakistan, Phase-II
Pakistan Oilseed Department

TABLE OF CONTENTS

1. INTRODUCTION

The Project "OliveCulture-holistic and multi-professional mechanism for a Pakistani Olive Value Chain" is an Italian scheme for empowering, strengthening, and assisting in the sustenance of the Pakistani Olive Oil Value Chain on several levels in a holistic participatory and multi-functional way, involving institution businesses, farmers, youth, women, and consumers to improve productive economic and qualitative performance.

The initiative is financed by the Italian Government and implemented by the Mediterranean Agronomic Institute, CIHEAM located in BARI, Italy in coordination with the Pakistan Oilseed Department (POD) of M/o National Food Security and Research (MNFS&R), the counterpart.

The Italian experts and trainers from research & education bodies in the technical agronomic field in rural development of the olive oil chain reputed to be internationally recognized Italian excellency constitute the core staff of CIHEAM BARI. The Project aims to streamline the already existing olive value chain on a scientific, educational, capacity-building basis in connection with good agronomic and agricultural practices in the sector to obtain a sustainable olive value chain for future needs along with a special emphasis on environmental resilience and culture enhancement through olive growing and its related industries.

Scientific name: *Olea europaea* L.

Family: Oleaceae

Common names: English: Olive. French: Olivier. Spanish: Olivo. Italian: Olivo. German: Olive. Arabic: Zeitoun. Urdu: Zaitoon. Punjabi: Kahoo. Pushto, Khauna.

Olive cultivation dates back more than 6,000 years and it is still flourishing today, not only in its countries of origin but in most areas of the world where acclimatization of its production can be possible. The olive is native to the Mediterranean region, tropical and central Asia, and various parts of Africa. The olive has a history almost as long as that of western civilization, its development being one of civilized man's first accomplishments.

BACKGROUND OF THE OLIVE CULTIVATION IN PAKISTAN

The olive was introduced in parts of Dera Ismail Khan (Now in present-day KP) in 1866, and efforts have been made for long to grow olive for domestic and agronomic purposes. The first attempt was by Mr. Henderson, who imported 100 European olive plants and planted them in Rawalpindi. During 1907-1910, the program was restarted with the help of an Italian expert who established a small saplings orchard at Soon Valley, Garhi Dopatta, and Chattar in 1907. Plantations were also established at Khari Murat in the Attock District, Sakesar, and Rakh Chandia in 1910. All these plantations were handed over to the Agriculture Department in 1927 and eventually ended up with the Forest Department in 1935. The plantation was also done at the Agriculture Research Institute Tarnab Peshawar KP in 1912. In 1935 some of the saplings were imported from Palestine, the USA, and Italy. In 1950-1952, olive plants were again

imported from Syria, Egypt, and Turkey and planted in Rawalpindi and Faisalabad region. In 1960 five thousand plants were procured from Italy and were planted at different locations of Pakistan.

The Pakistan Oilseed Developments Board (PODB) started work on olives in the year 2000 and adopted a two-pronged approach for the promotion of olive cultivation in the country (i) conversion of wild olives into bearing species by top working (ii) establishment of new plantation. A five-year project (2000-2004) "Accelerated Promotion of Olive in NWFP and Potohar" was initiated. Another 5-year duration project (2005-2009) "New Plantation of Olive in NWFP, Potohar and Balochistan and maintenance of Orchards Established by PODB" was initiated.

Since then, experiments have been conducted in a haphazard manner, which has not resulted in either increasing the area or production of olives, and the yield was too low to be of any commercial importance.

The real development and commercialization were kicked off in 2012 with a PIDSA-funded Olive promotion project. After this initiative, the Government of Pakistan funded a flagship olive cultivation project in 2014. The result of the plantations is that around 5. million olive plants are being have been nowadays cultivated. Along with this, a unique value chain including olive oil extraction units, table olive processing, and olive certification laboratories has been established and is in a developing trend.

The cultivated plants include mainly 21 different varieties, **Arbequina, Arbosana, Coratina, Koroneiki, Earlik, Gemlik, Frantoio, Picual, Ottobratica, Leccino, Pendolino, Chemlali, Ascolana, Manzanilla, Sevillano, Oliana, Chetoui, Souri, Nabali, Nocellara, and Hojiblanca,** grown across the country (suitable areas) mainly in marginal and undulated land.

However, a detailed study regarding specific acclimatized suitability and economic valuation was altogether missing. The phenological data of these varieties have now been technically and agronomically studied by Italian experts. They have divided Pakistani plantations into five varietal zones, each based on the suitability of microclimatic condition, the performance of good production and vegetative response, origin, purpose (oil and table), morphological characteristics (tree vigor, growth habit, canopy density, fruit type), bio agronomic and productive characteristics (abiotic and biotic stress, productivity (GAP), planting distance and production practices). These characteristics laid a foundation for future olive research to produce premium quality extra virgin olive oil. This document will also depict the holistic approach to olive agronomy to assist farmers in selecting high and consistent-yielding cultivars for maximum economic returns.

ASSUMPTIONS:

- **The selection of olive varieties in each province is the result of the collection of data conducted over three years, along with the behavioural adaptation of these varieties to different climatic zones over the last four decades. Both technicians and farmers**

have been actively involved in these observations and have played a significant role in the study.

- The research identified the valuation patterns of varietal behaviour in different macro zones, enabling the recommendation of specific varieties that are acclimated and capable of yielding economically viable outputs under prevailing conditions. This ensures that only those varieties that can adapt to the climate and provide an economic yield under current circumstances are recommended for each specific zone.
- The list of suggested varieties in each province has not to be considered exhaustive as additional well-suited cultivars could enrich the selection according to their behaviour in a specific macro/microclimate. Also, the provinces have different micro-climate zones.
- The study has raised some serious concerns about the real certification and traceability of olive varieties. In many cases, olive plants and plantations could be hardly identified as one single variety, and morphological characterization represents a non-exhaustive identification method that should be additionally verified through genetic means.

OBJECTIVES:

The major objectives of the study were as follows;

- Selection of suitable varieties in response to various agroclimatic conditions.
- Selection of high and consistent yielding varieties for maximum economic returns to ensure quantity and quality of extra virgin olive oil produced in the country.
- Selection of pest and disease-resistant varieties regarding their respective climate for cultivation.

FOCUS: CROSS-POLLINATION

The viability and sustainability of the olive industry depend on harvesting an economic yield of fruit, which can be used for oil production and table olives. Despite a profusion/abundance of flowers on olive trees, only a few set fruits in a growing season (Cuevas et al. 2001; Ghrisi et al. 1999; Marco et al. 1990; Martin 1990) and only about 1-2% of these fruits remain on the trees at maturity (Martin 1990). The reasons for this low fruit-to-flower ratio include the proportion of male-to-female flowers, climatic conditions during fruit set, and compatibility relationships among cultivars (Dal Pero Bertini 1960).

Most of the olive cultivars are self-incompatible, which means that self-pollination may not be possible. So, it is very important to have the presence of different compatible cultivars in the same area. Some cultivars are cross-incompatible, where flowers cannot be fertilized by pollen from certain other cultivars. Therefore, growers need to understand the cross-

compatibility between cultivars when planning an olive orchard in order to maximize fruit set and yields. This is especially important when orchards are planted in isolated areas where the only sources of pollen available are within the orchard. Thus, it is generally recommended that different bunch of suitable varieties be grown on a piece of land to fasten and facilitate accelerated pollination.

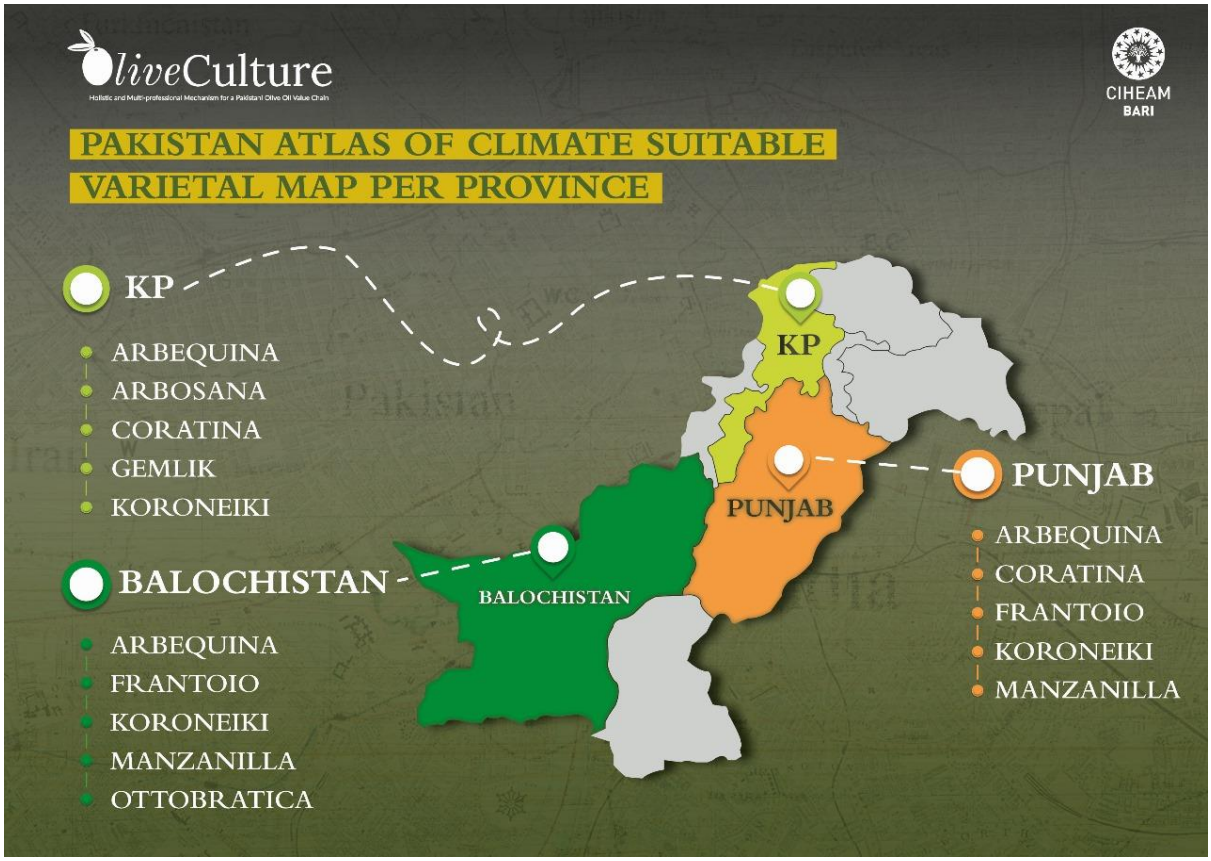
Usually, olive pollen is carried by wind by a hundred km so it is quite simple to have ovules fertilization in traditional olive countries even in mono-cultivar plantations. Because Pakistan is a very huge country with a low number of olive trees, it is highly suggested to plant together with the main selected cv, plants of different cultivars.

There are different classifications of olive flower compatibility. In one of the last research projects, all the cultivated olive varieties are divided into two groups, G1 and G2. It should give higher fruit sets, the combination between varieties of different groups. The wide presence of trees of wild olive species trees should be investigated in relation to their ability to produce compatible pollen.

The presence of flowers with male parts only indicates that these flowers are formed for the sole purpose of acting as pollen donors. The abundant amount of pollen, up to 200,000 pollen grains per flower, shows that they are adapted to be wind-pollinated. For successful cross-pollination to occur, it is necessary to have adequate amounts of compatible pollen available when the flowers are in bloom. This is possible if the compatible cultivars growing in the orchard have overlapping bloom times. Olive trees of the same cultivar growing under the same environmental conditions are known to bloom simultaneously (Dal Pero Bertini 1960). **(**Griggs et al. 1975) and (Ghrisi et al. 1999) that the bloom dates and duration vary among cultivars and between years. However, in most years the bloom time overlapped sufficiently for adequate pollination. (Lavee et al. 2002) the length of the flowering period depended on climatic conditions.

2. PAKISTAN ATLAS OF CLIMATE SUITABLE VARIETAL MAP PER PROVINCE

The picture here below is a graphical orientation for the main Olive Cultivars (commonly named Varieties) suggested for the main three olive-suited provinces of Pakistan. The selection is based on observations from different adaptability trials in each province considered and observed throughout the years for their stability, behavior, and performances. In any case, this is a non-exhaustive list of other possible Cultivars/Varieties that could be considered in present or future adaptability trials.



3. SELECTION OF BEST-YIELDING OLIVE VARIETIES DIVIDED BY PROVINCES

1. NAME OF THE VARIETY (+synonyms if there are): ARBEQUINA (FOR BALOCHISTAN – KHYBER PAKHTUNKHWA – PUNJAB)

ORIGIN: Spain

AREA OF SUITABILITY: Cold and Hot

PURPOSE: **oil**. Arbequina does not have good characteristics for table olives, having a small size and a relatively large bone.

MORPHOLOGICAL CHARACTERISTICS

TREE

VIGOR: **weak.** Arbequina olive tree is small to medium-sized, typically reaching a height of 3-5 meters (10-16 feet) at maturity, it typically exhibits slower growth and less extensive branching.

GROWTH HABIT: **spreading.** It is characterized by its tendency to develop branches that spread outward rather than growing upright.

CANOPY DENSITY: **medium.** It provides decent coverage of the fruit-bearing branches, it is not excessively dense. This characteristic allows for adequate light penetration and airflow within the canopy, which is important for promoting healthy fruit development and reducing the risk of diseases.

FRUIT

FRUIT WEIGHT: **small**. Arbequina is among the varieties of olives of size small, with just 1 or 2 grams, it has an oval shape and a dark purple to black color when ripe.

BALOCHISTAN

OIL CONTENT (% of fresh weight): (16% in Cold area) - (15% in Hot area) Arbequina olive has a high yield of oil in traditional culture. However, in super-intensive crops with productions of around 12 tons/ha, the yield of the Arbequina olive is 14%.

KHYBER PAKHTUNKHWA

OIL CONTENT (% of fresh weight): (14% in Cold area) – (12% in Hot area), Arbequina olive has a high yield of oil in traditional culture.

PUNJAB

OIL CONTENT (% of fresh weight): 13%, Arbequina olive has a high yield of oil in traditional culture.

PHENOLOGY (Specifically timings can vary depending on specific regional climates and environmental factors)

BALOCHISTAN

START OF VEGETATIVE GROWTH (BUD BURSTING): Late March, usually occurs in late winter to early spring, often around late March to early April, depending on local climate conditions.

FULL BLOOM: Late April, generally occurs a few weeks after bud bursting, typically in late spring, around late April to early May.

FRUIT TURNING (VERAISON): End of September, this stage marks the transition from green to purple or black coloration of the olives, indicating the onset of ripening. In the Arbequina variety, veraison typically occurs in late summer to early autumn, often around the end of September to October.

TIME OF HARVEST: mid-November to early December, Arbequina olives are typically harvested in late autumn to early winter, usually from November to December but the best oil quality is obtained at the end of October-November.

KHYBER PAKHTUNKHWA

START OF VEGETATIVE GROWTH (BUD BURSTING): early March, usually occurs in late winter, often around early March to late March, depending on local climate conditions.

FULL BLOOM: April, generally occurs a few weeks after bud bursting, typically in late spring to early summer, around early April to late April.

FRUIT TURNING (VERAISON): mid-September, In the Arbequina variety, veraison typically occurs in late summer to early autumn, often around mid-September to mid-October.

TIME OF HARVEST: October-November, Arbequina olives are harvested when ripe, and the best quality oil is obtained at the end of October-November.

PUNJAB

START OF VEGETATIVE GROWTH (BUD BURSTING): Late February, usually occurs in late winter, often around late February to mid-March, depending on local climate conditions.

FULL BLOOM: Late March, generally occurs a few weeks after bud bursting, typically in late spring to early summer, around late March to early April.

FRUIT TURNING (VERAISON): early September, veraison typically occurs in late summer to early autumn, often around early September to early October.

TIME OF HARVEST: October-November, they are typically harvested, usually from October-November.

BIO-AGRONOMIC AND PRODUCTIVE CHARACTERISTICS

SENSITIVITY TO BIOTIC STRESS:

- Medium resistant to verticillium wilt.

SENSITIVITY TO ABIOTIC STRESS:

- Resistant to cold, tolerance to salinity.

PRODUCTIVITY, GAP [GOOD AGRICULTURAL PRACTICES] applied:

- High and Constant. Arbequina is early bearing, with high and constant production. In addition, early harvesting is performed to obtain good-quality oils.

PLANTING DISTANCE:

- 6x4m
  18x12ft

PRODUCTION CHARACTERISTICS:

Light, smooth olive oil, Intense fruity fragrance, with a deep green color, a high percentage of oleic acid medium level of polyphenols.

2. NAME OF THE VARIETY (+synonyms if there are): ARBOSANA (FOR KHYBER PAKHTUNKHWA)

ORIGIN: Spain

AREA OF SUITABILITY: Hot

PURPOSE: Oil. It has a good characteristic to produce olive oil in quantity and quality.

MORPHOLOGICAL CHARACTERISTICS

TREE

VIGOR: **week**. Arbosana olive trees are relatively small to medium-sized, reaching heights of 4 meters (13 feet) at maturity.

GROWTH HABIT: **open-upright**. It refers to the growth pattern of the tree, where the branches tend to grow quite vertically, rather than spreading out horizontally.

CANOPY DENSITY: **medium**. The foliage of the tree provides moderate coverage of the fruit-bearing branches, it strikes a balance between providing shade for the fruit and allowing sunlight to reach the inner parts of the canopy.

FRUIT

FRUIT WEIGHT: **small**. Arbosana olives are small to medium-sized and oval-shaped with smooth skin. They have a green color when young, turning reddish-purple to black upon full ripening.

OIL CONTENT (% of fresh weight): 15%, the flesh of the fruit is relatively high in oil content.

PHENOLOGY (Specifically timings can vary depending on specific regional climates and environmental factors)

START OF VEGETATIVE GROWTH (BUD BURSTING): February-March, occurs in late winter to early spring, often around February to March.

FULL BLOOM: March-April, a few weeks after bud bursting, typically in late spring to early summer.

FRUIT TURNING (VERAISON): October, the transition from green to reddish-purple to black coloration of the olives, indicating the onset of ripening. In Arbosana olives, veraison typically occurs in late summer to early autumn.

TIME OF HARVEST: November, harvesting occurs in late autumn to early winter, usually from November.

BIO-AGRONOMIC AND PRODUCTIVE CHARACTERISTICS

SENSITIVITY TO BIOTIC STRESS:

- Sensitive to olive mites, Verticillium wilt, olive knot, and Olive Psyllids.

SENSITIVITY TO ABIOTIC STRESS:

- Sensitive to cold climates.

PRODUCTIVITY, GAP [GOOD AGRICULTURAL PRACTICES] applied:

- High and Constant. Arbosana olive trees are known for their high productivity, yielding a good quantity of olives per tree.

PLANTING DISTANCE:

- 6x4m
  18x12ft

PRODUCTION CHARACTERISTICS:

- Intense green fruity aroma, pungent, blended into other oils to improve their taste and aroma, medium level of polyphenols.

3. NAME OF THE VARIETY (+synonyms if there are): CORATINA (FOR KHYBER PAKHTUNKHWA – PUNJAB)

ORIGIN: Italy

AREA OF SUITABILITY: Cold and Hot

PURPOSE: **oil**. The Coratina olive variety is highly esteemed for its suitability in olive oil production.

MORPHOLOGICAL CHARACTERISTICS

TREE

VIGOR: **strong**. The Coratina olive tree is typically medium to large-sized, reaching a height of 5-7 meters (16-23 feet) at maturity. It is known for its strong vigor, which refers to its robust growth and vigorous branching.

GROWTH HABIT: **spreading.** It has an upright and spreading growth habit, with branches that tend to grow outward from the trunk.

CANOPY DENSITY: **dense**. It is known for having a dense canopy. This dense canopy provides good coverage of the fruit-bearing branches, which helps protect the olives from sunburn and promotes more uniform ripening.

FRUIT

FRUIT WEIGHT: **medium-large**. Coratina olives are medium-large-sized, elongated, and cylindrical in shape. They have a green color when young, turning to purple or black upon full ripening. The skin of the fruit is smooth, and the flesh is relatively high in oil content.

KHYBER PAKHTUNKHWA

OIL CONTENT (% of fresh weight): (16% in Cold area) – (14% in Hot area), Coratina EVOO has a very high number of polyphenols > (700) and has a high content of oleic acid (77%). Therefore, it is an oil of very high stability.

PUNJAB

OIL CONTENT (% of fresh weight): 12-14%, Coratina EVOO has a very high number of polyphenols > (700) and has a high content of oleic acid (77%). Therefore, it is an oil of very high stability.

PHENOLOGY (Specifically timings can vary depending on specific regional climates and environmental factors)

KHYBER PAKHTUNKHWA

START OF VEGETATIVE GROWTH (BUD BURSTING): March, it occurs in late winter to early spring, often around early to mid-March, depending on local climate conditions.

FULL BLOOM: late March to early April, it occurs a few weeks after bud bursting, typically in late spring, around March to April.

FRUIT TURNING (VERAISON): October-November, this stage marks the transition from green to purple or black coloration of the olives, indicating the onset of ripening. In the Coratina variety, veraison typically occurs in late summer to early autumn, often around mid-October to November.

TIME OF HARVEST: November, harvested in late autumn to early winter, usually in mid or end-November.

PUNJAB

START OF VEGETATIVE GROWTH (BUD BURSTING): February-March, it occurs in late winter to early spring, often around February to March, depending on local climate conditions.

FULL BLOOM: March-April, it occurs a few weeks after bud bursting, typically in late spring around late March to early April.

FRUIT TURNING (VERAISON): October, In the Coratina variety, veraison typically occurs in late summer to early autumn, often around September to October.

TIME OF HARVEST: November, it is harvested in late autumn to early winter, usually from Early to mid-November.

BIO-AGRONOMIC AND PRODUCTIVE CHARACTERISTICS

SENSITIVITY TO BIOTIC STRESS:

- Susceptible to olive peacock spot and wood rot

SENSITIVITY TO ABIOTIC STRESS:

- Particularly tolerant of cold

PRODUCTIVITY, GAP [GOOD AGRICULTURAL PRACTICES] applied:

- High and Constant. The Coratina variety is known for its high productivity, yielding a significant quantity of olives per tree.

PLANTING DISTANCE:

- 6-7x6 m
  18-21x18ft

PRODUCTION CHARACTERISTICS:

- Good organoleptic characteristics, Green with golden reflection in color, Oil particularly rich in polyphenols, very high fruity and powerful flavor with an intense spicy.

4. NAME OF THE VARIETY (+synonyms if there are): FRANTOIO (FOR BALOCHISTAN – PUNJAB)

ORIGIN: Italy

AREA OF SUITABILITY: Hot

PURPOSE: **oil.** Frantoio is rustic and also has very good characteristics for oil production.

MORPHOLOGICAL CHARACTERISTICS

TREE

VIGOR: **strong. The** Frantoio olive tree is medium-sized, typically reaching a height of 4-6 meters (13-20 feet) at maturity.

GROWTH HABIT: **upright.** It has an upright, columnar growth habit with dense foliage, making it suitable for high-density planting and efficient air circulation.

CANOPY DENSITY: **medium dense.** The canopy provides good coverage of the fruit-bearing branches, it is not overly dense. This characteristic allows for adequate light penetration and airflow within the canopy, which is essential for healthy fruit development and disease prevention.

FRUIT

FRUIT WEIGHT: **medium**. The fruit is medium-sized to large, with an elliptical or ovoid shape, it has a green to purple coloration when ripe, often turning black upon full ripening.

BALOCHISTAN

OIL CONTENT (% of fresh weight): 16-18%, it is renowned for its high oil content, making it a preferred choice for olive oil production, although this can vary depending on factors such as growing conditions, climate, and maturity at harvest.

PUNJAB

OIL CONTENT (% of fresh weight): 12%, it is renowned for its high oil content, making it a preferred choice for olive oil production, although this can vary depending on factors such as growing conditions, climate, and maturity at harvest.

PHENOLOGY (Specifically timings can vary depending on specific regional climates and environmental factors).

BALOCHISTAN

START OF VEGETATIVE GROWTH (BUD BURSTING): Late March, typically occurs in late winter to early spring, usually around March to early April, depending on local climate conditions.

FULL BLOOM: Late April, generally occurs a few weeks after bud bursting, typically in late spring, around April to May.

FRUIT TURNING (VERAISON): End of October, this stage marks the transition from green to purple or black coloration of the olives, indicating the onset of ripening. In the Frantoio variety, veraison typically occurs in late summer to early autumn, often around October to early November.

TIME OF HARVEST: November, it is typically harvested in late autumn to early winter, usually from November to December.

PUNJAB

START OF VEGETATIVE GROWTH (BUD BURSTING): February-March, typically occurs in late winter to early spring, usually around late February to early March, depending on local climate conditions.

FULL BLOOM: March-April, generally occurs a few weeks after bud bursting, typically in late spring, around March to early-April.

FRUIT TURNING (VERAISON): October, In the Frantoio variety, veraison typically occurs in late summer to early autumn, often around late September to early October.

TIME OF HARVEST: October-November, it is typically harvested in late autumn to early winter, usually in November.

BIO-AGRONOMIC AND PRODUCTIVE CHARACTERISTICS

SENSITIVITY TO BIOTIC STRESS:

- Susceptible olive knot, medium resistant to verticillium wilt.

SENSITIVITY TO ABIOTIC STRESS:

- Quite sensitive to cold and Frost.

PRODUCTIVITY, GAP [GOOD AGRICULTURAL PRACTICES] applied:

- High and Constant. The Frantoio olive tree is early in production and has high productivity it requires a greater number of chill hours to obtain maximum productive potential.

PLANTING DISTANCE:

- 6-7x6 m
  18-21x18ft

PRODUCTION CHARACTERISTICS:

- Rich, fruity flavor balanced by an aromatic, grassy nose, olive oil is dark green color, higher than average polyphenol value.

5. NAME OF THE VARIETY (+synonyms if there are): GEMLIK (FOR KHYBER PAKHTUNKHWA)

ORIGIN: Turkey

AREA OF SUITABILITY: Cold

PURPOSE: **dual**. This variety is valued for its versatility and is commonly used for both table olive consumption and olive oil production, making them a dual-purpose olive variety.

MORPHOLOGICAL CHARACTERISTICS

TREE

VIGOR: **medium**. It grows at a moderate pace and exhibits balanced vitality compared to other olive tree varieties. This implies that it requires a moderate amount of care and maintenance to thrive and is well-suited for various growing conditions.

GROWTH HABIT: **spreading**. growth habit extends its branches horizontally, creating a wide and sprawling appearance.

CANOPY DENSITY: **dense.** It refers to a thick and closely packed layer of foliage on the upper part of a tree or plant, providing ample shade and coverage.

FRUIT

FRUIT WEIGHT: **large**. Gemlik olives are medium to large in size, typically ranging from 2 to 4 centimeters in length. They have an elongated oval or cylindrical shape, often slightly asymmetrical. When ripe, Gemlik olives turn from green to shades of reddish-purple or dark purple, although some cultivars may remain greenish-black.

OIL CONTENT (% of fresh weight): 14%, it is highly regarded for its quality and unique flavor profile.

PHENOLOGY (Specifically timings can vary depending on specific regional climates and environmental factors)

START OF VEGETATIVE GROWTH (BUD BURSTING): March, it occurs in late winter to early spring, often around early to mid-March.

FULL BLOOM: March-April, a few weeks after bud bursting, typically in late spring, around April to May.

FRUIT TURNING (VERAISON): October, the transition from green to the reddish-purple or black coloration of the olives, indicating the onset of ripening. In Gemlik olives, veraison typically occurs at the end of October to early November,

TIME OF HARVEST: November, its harvesting occurs in late autumn to early winter, usually end of November.

BIO-AGRONOMIC AND PRODUCTIVE CHARACTERISTICS

SENSITIVITY TO BIOTIC STRESS:

- Sensitive to verticillium wilt, olive knot, and olive psyllids

SENSITIVITY TO ABIOTIC STRESS:

- Resistant to Cold Climate.

PRODUCTIVITY, GAP [GOOD AGRICULTURAL PRACTICES] applied:

- High and constant, Gemlik olives are renowned for their high and consistent productivity, reliably yielding abundant harvests of quality olives year after year, making them a desirable choice for olive oil production and table olive consumption.

PLANTING DISTANCE:

- 6x5m
  18x15ft

PRODUCTION CHARACTERISTICS:

- Use for both table and oil purposes, it tastes very intensive and burns with the high Polyphenol.

6. NAME OF THE VARIETY (+synonyms if there are): KORONEIKI (FOR BALOCHISTAN – KHYBER PAKHTUNKHWA – PUNJAB)

ORIGIN: Greece AREA OF SUITABILITY: **Hot**

(The hot regions of Balochistan, specifically due to its exceptional adaptability to arid and semi-arid climates, thrive in high temperatures, making it ideal for Balochistan's environment. Known for its drought tolerance and high-quality oil production. This variety is particularly well-suited to regions with high temperatures and minimal rainfall, characteristics that align closely with the climatic profile of Balochistan and offer both resilience and economic benefits to local farmers).

PURPOSE: **oil.** Olives are known for their high oil content; this high oil yield makes them highly desirable for oil extraction purposes.

MORPHOLOGICAL CHARACTERISTICS TREE

VIGOR: **medium strong**. Olive tree is typically small to medium-sized, reaching a height of 3-4 meters (10-13 feet) at maturity.

GROWTH HABIT: **spreading**. Koroneiki olive trees typically exhibit robust growth and vigorous branching. They can produce a large number of olives, contributing to their reputation as one of the most productive olive varieties.

CANOPY DENSITY: **sparse**. It provides good coverage of the fruit-bearing branches, which helps protect the fruit from sunburn and promotes more uniform ripening.

FRUIT

FRUIT WEIGHT: **small**. They have an oval or elongated shape and a green color when young, turning black upon full ripening.

BALOCHISTAN

OIL CONTENT (% of fresh weight): 16-18%, Koroneiki olive oil production is known for its high oil content, exceptional quality, and unique flavor profile, making it a prized commodity in the olive oil industry.

KHYBER PAKHTUNKHWA

OIL CONTENT (% of fresh weight): 14%, Koroneiki olive oil production is known for its high oil content.

PUNJAB

OIL CONTENT (% of fresh weight): 10-12%, oil production in the Punjab region, An olive oil of superb quality and low acidity levels, rich in flavor and aromas.

PHENOLOGY Specifically timings can vary depending on specific regional climates and environmental factors).

BALOCHISTAN

START OF VEGETATIVE GROWTH (BUD BURSTING): April, typically occurs in late winter to early spring, often around early to mid-April, depending on local climate conditions.

FULL BLOOM: late April, generally occurs a few weeks after bud bursting, typically in late spring to early summer, around mid to late April.

FRUIT TURNING (VERAISON): October-November, this stage marks the transition from green to purple or black coloration of the olives, indicating the onset of ripening. In the Koroneiki variety, veraison typically occurs in late summer to early autumn, often around October to mid-November.

TIME OF HARVEST: November-December, Koroneiki olives are harvested in late autumn to early winter, usually from November to mid-December.

KHYBER PAKHTUNKHWA

START OF VEGETATIVE GROWTH (BUD BURSTING): March, typically occurs in late winter to early spring, often around mid to late March, depending on local climate conditions.

FULL BLOOM: April, generally occurs a few weeks after bud bursting, typically in late spring to early summer, around early to late April.

FRUIT TURNING (VERAISON): October-November, Veraison typically occurs often around mid-October to November.

TIME OF HARVEST: November, they are harvested in late autumn to early winter, usually mid to end of November.

PUNJAB

START OF VEGETATIVE GROWTH (BUD BURSTING): Late February, typically occurs in late winter to early spring, often around February to March, depending on local climate conditions.

FULL BLOOM: Late March, generally occurs a few weeks after bud bursting, typically in late March to early April.

FRUIT TURNING (VERAISON): October, veraison typically occurs in late summer to early autumn, often around the end of September to October.

TIME OF HARVEST: November, Koroneiki olives are typically harvested, usually from early to mid-November.

BIO-AGRONOMIC AND PRODUCTIVE CHARACTERISTICS

SENSITIVITY TO BIOTIC STRESS:

- Resistant to olive leaf spot, Sensitive to olive knot.

SENSITIVITY TO ABIOTIC STRESS:

- Resistant to drought but does not tolerate cold.

PRODUCTIVITY, GAP [GOOD AGRICULTURAL PRACTICES] applied:

- High and Constant. Koroneiki olive variety's combination of high production levels, consistency in yield, and quality oil production makes it a preferred choice for olive oil producers seeking reliable and premium-quality olive oil.

PLANTING DISTANCE:

- 6x5m
  18x15ft

PRODUCTION CHARACTERISTICS:

- Very high level of polyphenols, green color, a fruity and delicate flavor, and is characterized by a very strong aroma, rich in precious organoleptic substance.

7. **NAME OF THE VARIETY (+synonyms if there are): MANZANILLA (FOR BALOCHISTAN – PUNJAB)**

ORIGIN: Spain

AREA OF SUITABILITY: Cold and Hot

PURPOSE: **dual**. It has a good size of fruit and can be used for both oil and table purposes.

MORPHOLOGICAL CHARACTERISTICS

TREE

VIGOR: **weak medium**. The Manzanilla olive tree is typically medium-sized, reaching a height of 4-7 meters (13-23 feet) at maturity.

GROWTH HABIT: **spreading**. it has a spreading growth habit with an open canopy, which allows for good sunlight penetration.

CANOPY DENSITY: **medium**. It provides decent coverage of the fruit-bearing branches, and it is not overly dense.

FRUIT

FRUIT WEIGHT: **small.** Manzanilla olives are large in size, typically ranging from 5 to 10 grams each. They have an oval or round shape with smooth and firm skin. When ripe, Manzanilla olives turn straw-yellow in color.

BALOCHISTAN

OIL CONTENT (% of fresh weight): (16% in Cold area) - (14% in Hot area), primarily used for table olive consumption due to their large size, firm texture, and mild flavor. but can be used for oil purposes having a good amount of oil.

PUNJAB

OIL CONTENT (% of fresh weight): 10%, primarily used for table olive consumption due to their large size, firm texture, and mild flavor and due to the very low percentage in the province.

PHENOLOGY (Specifically timings can vary depending on specific regional climates and environmental factors)

BALOCHISTAN

START OF VEGETATIVE GROWTH (BUD BURSTING): late March, occurs in late winter to early spring, depending on local climate conditions.

FULL BLOOM: April, it occurs a few weeks after bud bursting, typically in late spring to early summer.

FRUIT TURNING (VERAISON): September, the transition from green to the straw-yellow coloration of the olives, indicating the onset of ripening. In the Manzanilla variety, veraison typically occurs in late summer to early autumn, often around the end of September to early October.

TIME OF HARVEST: October, it is harvested when ripe, which occurs in late autumn to early winter.

PUNJAB

START OF VEGETATIVE GROWTH (BUD BURSTING): early March, occurs in late winter to early spring, often around late February to early March, depending on local climate conditions.

FULL BLOOM: April, it occurs a few weeks after bud bursting, typically in late spring to early summer.

FRUIT TURNING (VERAISON): August, in the Manzanilla variety, veraison typically occurs in late summer to early autumn, often around the end of August to early September.

TIME OF HARVEST: September, it is harvested in late autumn to early winter.

BIO-AGRONOMIC AND PRODUCTIVE CHARACTERISTICS

SENSITIVITY TO BIOTIC STRESS:

- Very sensitive to verticillium wilt, sensitive to anthracnose and olive knot.

SENSITIVITY TO ABIOTIC STRESS:

- Tolerant to Cold and drought.

PRODUCTIVITY, GAP [GOOD AGRICULTURAL PRACTICES] applied:

- High and Alternate. Manzanilla olive trees are known for their productivity, yielding a good quantity of large-sized olives per tree, and having alternate bearing in production

PLANTING DISTANCE:

- 6x4m
  18x12ft

PRODUCTION CHARACTERISTICS:

- Uses for both table and oil purposes, low amount of poly phenols medium fruit size, with deep green color, the taste is sweet to touch, slight bitterness and some spicy presence in the throat.

8. NAME OF THE VARIETY (+synonyms if there are): OTTOBRATICA (FOR BALOCHISTAN)

ORIGIN: Italy

AREA OF SUITABILITY: Cold

PURPOSE: **oil**. It is considered one of the finest olive oils available, making it a valued commodity in the global olive oil market.

MORPHOLOGICAL CHARACTERISTICS

TREE

VIGOR: **strong**. It has a strong vigor as compared to other olive cultivars, Ottobratica olive trees typically exhibit robust growth, with strong and vigorous branches. They can produce a significant quantity of olives, contributing to their reputation as a productive olive variety.

GROWTH HABIT: **erect**. The branches grow more vertically, rather than spreading out horizontally. Olive trees with an erect growth habit have branches that tend to grow upward, giving the tree a more upright appearance.

CANOPY DENSITY: **dense**. The canopy density of Ottobratica olive trees contributes to their productivity and the quality of the olives they produce, the trees are closely packed, providing extensive coverage of the fruit-bearing branches.

FRUIT

FRUIT WEIGHT: **small**. Ottobratica olives are small-sized and oval-shaped with smooth skin. They have a green color when young, turning black upon full ripening.

OIL CONTENT (% of fresh weight): 18-20%, The flesh of the fruit is relatively high in oil content.

PHENOLOGY (Specifically timings can vary depending on specific regional climates and environmental factors)

START OF VEGETATIVE GROWTH (BUD BURSTING): late March, it occurs in late winter to early spring, often around mid to late March,

FULL BLOOM: late April, it occurs a few weeks after bud bursting, typically in late spring to early summer, around April.

FRUIT TURNING (VERAISON): October-November, the transition from green to purple or black coloration of the olives, indicating the onset of ripening. In Ottobratica olives, veraison typically occurs mid to end of November.

TIME OF HARVEST: November-December, it is harvested when fully ripe, which occurs in late autumn to early winter, usually from November to December.

BIO-AGRONOMIC AND PRODUCTIVE CHARACTERISTICS

SENSITIVITY TO BIOTIC STRESS:

- Tolerant to olive knot and leaf spot.

SENSITIVITY TO ABIOTIC STRESS:

- Resistance to drought, humidity, and strong temperature change.

PRODUCTIVITY, GAP [GOOD AGRICULTURAL PRACTICES] applied:

- High and Alternate. Ottobratica olive trees are known for their high production potential, but they may also exhibit alternate bearing behavior. Pruning should be performed extensively on Ottobratica olive trees, which are known for their strong vigor, significant height, and dense canopy. Conduct heavy pruning to remove dead, diseased, or damaged wood, thin out dense areas to enhance airflow and sunlight penetration, and reduce overall height by cutting back the tallest branches. This practice helps maintain tree health, promotes even fruit ripening, and minimizes the risk of pest and disease problems.

PLANTING DISTANCE:

- 6-7x6 m
  18-21x18ft

PRODUCTION CHARACTERISTICS:

- Oil is yellow in color with greenish nuances, characterized by bitterness and vegetable scent flavors, and naturally rich in polyphenol

4. CONCLUSION

A detailed perspective document titled "Selection of Olive Cultivars and their Potential by Province" has been prepared to facilitate the olive stakeholders to plant the correct olive variety in their respective climates. The conclusion drawn from this document, prepared by experts from the OliveCulture Project with CIHEAM Bari Italy, is to select olive cultivars and their potential per province that can be better grown in Pakistan i.e. Balochistan, Khyber Pakhtunkhwa, and Punjab. It also depicts the potential of exuding economic value of the olive tree i.e. fruit that can be used for olive oil processing and table purposes essential for the maintenance and sustainability of the value chain system in Pakistan.

By categorizing olive varieties according to the specific climatic conditions of each province, the study aims to address the challenge of planting olive varieties in unsuitable climates. Through careful selection and management, olive cultivation can be optimized in Pakistan's diverse climatic regions, contributing to the growth of the olive industry and agricultural sustainability in the country.

BALOCHISTAN

Olive cultivation presents an opportunity for agricultural development in the province of Balochistan. Situated in the arid and semi-arid regions of the country, the province boasts agroecology and agroclimatic conditions that favor the cultivation of Olea europaea. Particularly in the areas north of Quetta, including Zhob, Killa Saifullah, Loralai, and surrounding areas, the conditions align favorably for the growth and flourishing of olive orchards.

Balochistan's terrain and varying altitudes contribute to diverse microclimates, providing suitable niches for olive cultivation. The region experiences a predominantly dry climate with low precipitation, which is conducive to olive cultivation, as the tree thrives in well-drained soils and can withstand periods of drought. Additionally, winter-summer day & night temperature fluctuations characteristic of the Balochistan climate further support the necessary chilling hours needed for optimal flowering of the olive tree.

Balochistan, as referred in the document, can be divided into two distinct areas: the area north of Quetta experiences colder winters and mild summers. The region south of Quetta is characterized by a warmer climate with hot summers and milder winters. By harnessing the adaptability of olive trees to the province's agroecology and agroclimatic suitable conditions, Balochistan will greatly be benefitted, economically and environmentally, from the establishment of thriving olive orchards.

As a drought-tolerant crop, olives can be a valuable addition to Balochistan's agricultural portfolio, offering resilience in the face of water scarcity and climatic variability.

Balochistan may have more areas with suitable soil and climatic conditions for olive cultivation, thorough site assessment, soil testing, and proper management practices, which are essential to ensure the successful establishment and production of olive orchards in the region.

KHYBER PAKHTUNKHWA

Khyber Pakhtunkhwa (KP) exhibits diverse agroclimatic conditions across its variable topography, ranging from plains to mountains, which supports a wide range of agronomic & horticultural crops including olives. Geographically, the province is divided into two zones, the northern zone, and the southern zone. The region features distinct and particular climatic zones: arid southern areas with hot summers with temperature exceeding 40°C and mild winters having temperature regime from 15-25°C characterized by low humidity conducive to olive cultivation. Central regions experience semi-arid conditions with hot summers, cool winters, and moderate rainfall, necessitating good drainage for successful olive farming. Northern areas offer mild summers, cold winters, and less humidity providing suitable conditions for certain olive varieties.

KP's agroecology includes plains, valleys, foothills, and high-altitude areas, each presenting specific advantages and considerations for olive cultivation. Factors such as temperature, optimal rainfall (between 400-600 mm annually with good drainage), and humidity levels (preferably low to moderate to minimize diseases) significantly influence olive farming practices in the region. Given this climatic diversity, conducting scientific studies to identify appropriate olive varieties and determine optimal cultural practices tailored for each location. The region experiences a Mediterranean-like climate with hot, dry summers and mild, wet winters, which are ideal conditions for olive trees. The well-drained soils and abundant sunlight further support the growth and productivity of olives. Additionally, the elevation variations allow for the cultivation of different recommended olive varieties, enhancing the overall yield and quality of the produce.

PUNJAB

The climate of Punjab for olive plantations is characterized by higher humidity and seasonal monsoon rains. The province experiences hot summers and relatively mild winters. The area receives the majority of its rainfall during the monsoon season (July to September), which can be both a boon and a challenge for olive cultivation. The monsoon provides necessary water for olive trees, especially during dry spells, potentially reducing the need for supplementary irrigation. However, excessive rainfall can lead to waterlogging, root rot, and other waterborne diseases, while high humidity levels can promote fungal infections like anthracnose on olive fruit and other pests. It can affect olive cultivation if not managed properly. The olive varieties recommended for cultivation can tolerate higher humidity levels and occasional periods of heavy rainfall. The climate may also present unique challenges in terms of pest and disease management for olive cultivation. With appropriate management practices, olive farming can thrive in Punjab's diverse climatic conditions.

5. REFERENCES

A. Rahman Khan, Salahuddin Solaiman. 1979. Pakistan Agricultural Research Council. Status Paper on Olive Cultivation in Pakistan.

Cuevas J, Diaz-Hermoso AJ, Galian D, Hueso JJ, Pinillos V, M. P, Sola D, Polito VS (2001) Response to cross-pollination and choice of pollinisers for the olive cultivars (Olea europaea L.) 'Manzanilla de Sevilla', 'Hojiblanca' and 'Picual'. Olivae 85: 26-32.

Dal Pero Bertini GV (1960) Olive growing and processing. Commonwealth Scientific and Industrial Research Organisation, Melbourne.

Griggs WH, Hartmann HT, Bradley MV, Iwakiri BT, Whisler JE (1975) Olive pollination in California. Division of Agricultural Sciences, University of California, California, U.S.A., 50 p.

Ghrisi N, Boulouha B, Benichou M, Hilali S (1999) Agro-physiological evaluation of the phenomenon of pollen compatibility in olive. Case of the Mediterranean Collection at the Menera Station, Marrakech. Olivae 79: 51-59.

International Olive Council (IOC): World Catalog of Olive Varieties, https://www.internationaloliveoil.org/product/world-catalogue-of-olive-varieties/

International Olive Oil Council (IOC): World Olive Encyclopedia, https://www.internationaloliveoil.org/product/world-olive-encyclopedia/

Lavee S, Taryan J, Levin J, Haskal A (2002) The significance of cross-pollination for various olive cultivars under irrigated intensive growing conditions. Olivae 91: 25-36.

Marco Ld, Giovannini D, Marra FP, Viglianisi G (1990) Reproductive and vegetative behaviour of four table olive cultivars. Acta Horticulturae 286: 187-190.

Martin GC (1990) Olive flower and fruit population dynamics. Acta Horticulturae 286: 141-153.

OliveCulture Project (Holistic and Multi-Professional Mechanism for a Pakistani Olive Oil Value Chain with Italy) Field Observations of the Year 2022-2023 from Balochistan, Khyber-Pakhtunkhwa, and Punjab Province.

OliveCulture

Holistic and Multi-professional Mechanism for a Pakistani Olive Oil Value Chain

SELECTION OF OLIVE CULTIVARS FOR THE MAIN PROVINCES IN PAKISTAN

ITALIAN AGENCY FOR DEVELOPMENT COOPERATION

REPVBBLICA ITALIANA

CIHEAM BARI