Comparison of Selected Rye Grass *(Lolium multiflorum)* Varieties for Soil Protection, Forage yield and Quality

Qurat-ul-Nain (179-FBAS/MS/F13)

Supervisor

Dr. Rukhsana Tariq (Assistant Professor)

Co Supervisor

Dr.Imtiaz Qamar (Director of Range Research Institute) NARC

Department of Environmental Sciences

Faculty of Basic and Applied Sciences

International Islamic University Islamabad

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِيْمِ

In the Name of Allāh, the Most Gracious, the Most Merciful

Department of Environmental Sciences
International Islamic University Islamabad

Dated: _____

FINAL APPROVAL

It is certified that we have read the thesis submitted by Ms Qurat-ul-Nain 179FBAS/MSES/F13 and it is our judgment that this project is of sufficient standard to warrant its acceptance by the International Islamic University, Islamabad for the M.S Degree in Environmental Sciences

COMMITTEE

External Examiner
Dr. Hina Fatima Assistant Professor
Environmental Biology Climate Change
AIOU.

Internal Examiner
Dr. Maliha Asma
Assistant Professor DES
IIUI

Supervisor
Name Designation Dr. Rukhsana Tariq
Department Assistant Professor DES
University IIUI

Dr Rukhsana Tariq
Assistant Professor
DES ENV. SCIS

Co-Supervisor
Name Dr. Imtiaz Qamar
Designation Director of RRI
University NARC

Chairperson, DES
Name Dr. Maliha Asma
FBAS, IIUI

Dean FBAS
Dr. Muhammad Sher
IIUI

DEDICATION

This work is dedicated to my loving and precious parents, my teachers, and the long lasting company of friends and to the people who enlighten ways of our life.

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All praises and thanks to **Allah**, the **Almighty** alone, the most Merciful and the most Compassionate who is the entire source of knowledge and wisdom to mankind it is He who blessed us courage ability and fortitude to accomplish this research work within the required time period. All praises and respect for **Holy Prophet (P.B.U.H)** who preached the followers seek knowledge from cradle to grave.

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May Allah Bless Them All

Qurat-ul-Nain

LIST OF ABBREVIATION

NARC	National Agriculture Research Centre
RRI	Range Research Institute
S.O.V	Source of Variation
DF	Degree of Freedom
DW	Dry Weight
FW	Fresh Weight
PH	Plant Height
P	Probability Value
SQ	Square
LSD	Least Significant Difference
MIN	Minimum
MAX	Maximum
CV	Co efficient of Variation
NS	Non-significant

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Abstract

The aim of this study was to investigate four varieties of rye grass *(lolium multiflorum)* for soil protection, soil binding their quality and forage yield. The Study was conducted in RRI (Range Research Institute) NARC (National Agricultural Research Centre), Islamabad. The significance of the grass variety should not be ignored.

Four varieties of rye grass *(lolium multiflorum)* of which Rye one is local and other three varieties Accelerate, Makkhan, Emmerson are imported from Australia. Dry weight, fresh weight and plant height of these four varieties was analysed at four growth stages i.e. germination, vegetative, flowering and maturity. Field trials were taken. Different climate parameters like temperature and rainfall were studied to check the impact on their growth over all among these four varieties Makkhan was the variety which has greater fresh weight and dry weight than other three varieties, Makkhan had shown good result with respect to number of tillers, and number of plants per square meter. This study most significantly showed that Makkhan is the variety which can be adopted to reduce soil erosion.

CHAPTER 1

INTRODUCTION

Introduction

In this chapter an introduction to the significance of range lands, its present condition, environmental benefits, and rehabilitation is provided. Environmental science incorporates several disciplines since it studies the contact among physical, chemical and biological components relating to environment and investigates the relationship between different species either plants or animals with their environment.

1.1Significance of Range Lands

Environment and natural resources are the big source of food and energy for human. Total area of Pakistan is 87.98 million ha of which 50.88 million ha are rangelands. Accordingly these rangelands are the most important food-foundation of around 97 million heads of livestock. *(Mohammad, 1989).*

Rangelands show an important part in the livelihoods development of massive number of rural deprived and needy people through nurture of animals and gaining a variety of harvests and amenities. In addition, rangelands play key role in improving infiltration procedure, leading to maintainable water stream in the down watercourses, and abridged soil erosion. They are also donate the ecological constancy to some of the significant ecosystems of the country. *(National Range land Policy 2010).*

Subdivision's influence on the livestock in the GDP is additional than 11 percent. Out of this 58 percent rangeland area, only five percent lies in the high-rainfall rangelands of Alpine pastures (1.68 million ha) and Himalayan grazing lands (0.67 million ha). Rest of the rangelands are situated in arid and semi-arid areas of the country where annual precipitation seldom exceeds 300mm. Due to climatic and topographic limitations, these areas are not fit for other land-uses like forestry or permanent cultivation. Hence, livestock grazing on rangelands constitutes the biggest land-use in the country. Rangelands provide nearly 60 percent of feed for sheep and goats; about 40 percent for horses, donkeys, and camels; and only five percent for the cattle and buffaloes *(Afzal et al., 2008).*

In Pakistan there are five unlike kinds of range environmental zones (Sub-alpine and temperate, Sub-tropical humid, Sub-tropical sub humid, Hot and semi-hot deserts plains, and Mediterranean). *(Ahmad et al., 2008).*

The significance of range lands for Pakistan cannot be under estimated at any cost as these cover 40,55,60,79,30 and 45% areas of Punjab, Sindh, N.W.F.P, Baluchistan, Northern areas and Azad Kashmir respectively *(Khan et al., 2008)*.

From current statistics we get to know that the total number of livestock is in the tune of 154 million in the country promoting around 35 million people making around 40% of their revenue from nurturing of livestock. More than 60% livestock feed requirement are met from the rangelands. In this situation, in various parameters the importance of the rangeland is high encircling ecological, social; and economical parameters. *(National Range land Policy 2010)*.

In non-agricultural marginal areas Livestock browsing signifies an organisation of land management, while, livestock grazing on rangeland signifies the most appropriate land use. 30 million herds of livestock are supported by rangelands, which donate US $ 400 million to Pakistan's yearly export earnings. *(Sultan et al., 2008)*.

1.2 Present Condition of Range land in Pakistan

To the interactions of various biological, environmental and social factors Range management and development is always a tough task. Trends have been altered from traditional range management methods like ignoring the social and traditional aspects of range management and observing and concentrating only on the biological issues and to community built and co-management approaches. In terms of environmental services like carbon sequestration, watershed management, bio-diversity and eco-tourism it is hard to determine the value of rangelands. In arid and semi-arid areas rangelands are the major free grazing areas for livestock round the year. *(Ahmad et al., 2012)*.

In Pakistan, more than 60% of the area of the country has categorically been declared as rangeland, which is the biggest land use of the country. This vast natural resource of country is not being managed on scientific basis and at present, only 10-15% of their actual potential is being realized. Apart from forage available from the rangelands of the country, about 2.7 m.ha of the cultivated commanded area is under fodder production in the country, which is not adequate even to uphold the necessities of livestock Looking at the current situation of rangeland productivity in Pakistan, it is need of the time that conditions should be improved to increase the forage productivity of the degraded rangelands. High yielding and palatable grass species are in supreme importance that should be recognized in their suitable eco sites. *(Arshadullah et al., 2012)*.

1.3 Environmental Benefits and Importance of Grasses

Annual ryegrass *(lolium multiflorum)* is a dynamic cool-season grass with a widespread fibrous root system. When it is cast-off as a cover crop, annual ryegrass *(lolium multiflorum)* helps preclude erosion, it helps to builds soil organic matter, recovers soil tilth, captures residual nitrogen and it also can meaningfully increase the rooting depth of crop. *(Plumer. M. et al., 2013)*.

The more the percent cover of a grass more the protection against the soil erosion different grasses have tendency of spreading roots and shoots at different percent. The number of plants per square meter represent the density of plants.

Ryegrass *(Lolium multiflorum)* is finest adapted to humid, cool surroundings where temperatures in the winter or summer are not extreme. *(Carter .K.)*

Annual ryegrass *(Lolium multiflorum)*, is closely related to perennial ryegrass *(Lolium perenne* L) it is also called Italian ryegrass, is a high-quality, cool-season, winter annual bunchgrass. At the base it is yellowish in colour, with glossy leaves. The leave colour of annual ryegrass is dark green and shiny with smooth boundaries and clasping auricles. As the seed heads established Plants can grow to more than 3 feet in height. *(Lace field et al., 2003)*.

Even in low fertility and acidic soils the plants form a widespread, dense root system, which helps to make it a better contender for the use of soil erosion on slanted fields and grassed waterways. Its dynamic root system obstinately holds the soil contrary to erosion whereas refining soil organic matter levels, growing water infiltration, and helps to reduce nitrate leaching. Annual ryegrass *(Lolium multiflorum)* is best for developed, cooler elevations and moist areas. Annual ryegrass *(Lolium multiflorum)* grows on a wide variety of soil types and has a preferred soil pH range of 5.5–7.0. If well-established it does well on heavy, temporarily waterlogged soils. It does not stand shade for extended periods. Annual ryegrass is best suited to higher, cooler elevations and humid areas. *(Brown, 2002)*.

Annual ryegrass *(Lolium multiflorum)* is closely related to perennial ryegrass and can be readily crossed with it. Perennial ryegrass is soil stabilization a valuable forage plant. Perennial ryegrass has a number of positive qualities which includes high seedling vigour, leafiness, better quality, better palatability, and fast recovery after harvest. One of the best plants used for assessment of air quality due to pollution by trace elements is Italian ryegrass *(Lollium multiflorum* L*)*. After swoing this annual species is characterized by very rapid growth. Rapid growth rate causes fast nutrient uptake as well as helps easy trace element adsorption. *(Borowiak et al., 2014)*.

1.4 Range lands as a source of Livestock Development.

One of the initial achievements of human beings is domestication of livestock. It made their lives more prolific, easy and secure. Since those early days, livestock has aided them well. It still does so in Pakistan where it is an essential part of the rural economy contributing significantly to the agriculture and the national GDPs. Livestock raising in Pakistan is primarily an existence activity and is characterized by small flocks/herds with extensive ownership.*(Usmani . R. H., Hasnain .H.U 2006).*

In Pakistan the livestock population is maintained by feed resources that are resulting mainly from crops, fodder, rangelands and other grazing areas, and from agro-industrial by-products. It is projected that current feed resources are lacking by 29 and 33 % for total digestible nutrients (TDN) and crude protein (DP) respectively.

1.5 Rangeland Destruction: An Environmental Hazard

Many aspects like climate, human, animals are causing the degradation of rangelands. The pointers of rangeland degradation may vary from region to region but the common ones are removal of chosen species, decrease in plant cover and bio-diversity, reduction in forage production, and enlarged soil erosion and runoff of rain water with little or no infiltration. All these factors are foremost contributing towards desertification. *(Ahmad et al., 2012).*

1.6 Rangeland Rehabilitation

Current productivity of the majority rangelands varies from 25-50% of their potential. The main reasons for this deteriorated condition are the increased no of livestock beyond the carrying capacity, improper land use and mismanagement. The increased human population pressure also affect the rangeland by converting rangelands to agriculture, and forest lands, soil erosion and degradation. The overgrazing has also resulted in the species composition towards less palatable forage species including the wide-spread weed and poisonous plants in a number of range and pasture ecosystem. The other contributing factors are climate change and global warming. Resultantly desertification and decline in bio-diversity are common phenomenon. *(National Range land policy 2010).*

Aims and Objectives

To assess the quality of Rye grass by:

1. Calculating the rate of seed germination
2. Calculating the forage yield, productivity and quality of Rye grass in comparison of other local varieties.
3. Calculation of number of plants per unit area and number of tillers/plants to determine the soil cover to reduce runoff.

CHAPTER 2

LITERATURE REVIEW

Literature Review

Numerous studies have demonstrated that vegetation coverage is very important to control soil erosion by water. However, the combined impacts of plant roots and shoots on soil erosion by water and the relative contributions of the roots and shoots are not clearly understood. Four rainfall simulation experiments with the rainfall intensity at 1.5 mm min^{-1} were conducted at an interval of 5 weeks to investigate the effects of ryegrass (*Lolium perenne* L.) shoots and roots on soil erosion and runoff reductions.

Both the soil erosion rate and average infiltration rate were linearly correlated with root surface area density in cm^2 root surface area per unit soil volume. Ryegrass planting could improve soil physical properties, especially soil aggregate stability. The study results are probably useful in evaluating the effects of plant shoots and roots on soil erosion control. (Zhou, Z. C., Shangguan, Z. P., (2007).

In the study reported here, lime responses of annual (*Lolium multiflorum)* and perennial (*Lolium Perrene*) rye grasses were evaluated in irrigated field trials located on acidic highly weathered soils. Annual rye grass was found to be more markedly more tolerant of soil acidity than perennial ryegrass. *(Natal, .K. Z., (2000).*

Annual ryegrass (Lolium multiflorum Lam.), also called Italian ryegrass, is a high-quality, cool-season, winter annual bunchgrass that is closely related to perennial ryegrass (Lolium perenne L.). Annual ryegrass is widely adapted. Though it is best adapted to fertile, well-drained soils, it can survive and make good growth on wetter soils. Annual ryegrass is recognized as one of the highest quality cool-season grasses. Annual ryegrass can be used for hay, silage, grazing, and soil conservation. *(Lacefield, G., et al., (2003).*

The experiment was carried out in 2011 *Lolium multiflorum* L. exhibits several properties useful for active bio monitoring of air pollution. Bio indicator plants have an ability to accumulate trace elements present in aerosols as, well as capacity to adsorb trace elements through the root system. One of the most popular plants used for evaluation of air quality due to pollution by trace elements is Italian rye grass *(Lolium multiflorum).* This is an annual species

characterized by very fast growth after sowing. Fast root growth causes fast nutrient uptake as well as easy trace elements adsorption. *(Borowiak. K., et al., (2011).*

Perennial ryegrass is used for dryland pastures or irrigated for grazing, hay or silage. It has excellent seedling vigour which makes it easy to establish and it has a rapid recovery after grazing.

Perennial ryegrass has a wide range of adaptability to soils. Perennial ryegrass is very nutritious having similar or higher energy and protein levels than most proven pasture grass alternatives. Preliminary forage quality results from a Montana study indicated good potential for high production of both protein and total digestible nutrients (TDN) per acre. *(USDA NRCS 1996).*

Annual ryegrass is a vigorous cool-season grass with an extensive fibrous root system. When used as a cover crop, annual ryegrass helps prevent erosion, builds soil organic matter, improves soil tilth, captures residual nitrogen and can significantly increase the rooting depth of crops. This publication covers the management practices essential to growing a successful annual ryegrass cover crop. *(Plummer. M., et al., 2013)*

The research was taken for carbon sequestration in cropping system. The study has constructed Carbon budgets for two temperate grass species, perennial ryegrass (Lolium perenne L.) and annual ryegrass (L. multiflorum Lam.). The data establish a baseline that will be useful for evaluating Carbon cycling in grass seed production systems. *(Griffith, S.M. et al., 2010)*

This research was taken to show Crop dry matter increments against time scale for exotic grass species during vegetative growth period. Difference in growth of the species with similar climate and inputs revealed variations do exist among the species. It was noticed that grasses e.g. *Lolium perenne, Lolium multiflorum* were able to show relatively better sigmoid curves for the study period. Among the grasses, *Lolium multiflorum* was observed the highest in fresh matter production .*Lolium perenne* was next high yielding species with about 2631 g m-2 fresh matter production. *(Pak. J. Bot., 43(3): 1557-1561, 2011)*

Perennial Ryegrass is well suited to soil conservation uses. Its extensive, shallow, fibrous root system makes it effective for reducing soil erosion. Perennial Ryegrass responds rapidly to fertilization. Its principal nutrient is nitrogen, which is normally applied at the rate of 150 pounds per acre. A very rapid starter, Perennial Ryegrass will normally germinate in 7 to 14 days or even less under ideal conditions. *(Oregon State University Extention Service, PNW 501, April 1999)*

In this study growth characteristics of ryes grass are discussed mature perennial ryegrass plants in pastures persist through the asexual reproduction of the tiller. Leaves are initiated from the flanks of the tiller stem apex. Generally, two leaves arc growing on a tiller at any one time. New tiller buds may arise from the axils of mature leaves depending on environmental conditions. Flowering results from a physiological change at the stem apex, which then produces a seed head but no further leaves, eventually resulting in the tiller dying. This phenomenon and other environmental changes result in marked seasonal trends in ryegrass tiller .densities. Leaf, tiller, and root production rates are sensitive to light and temperature where nutritional factors are not limiting. Tillering rates also change with stage of regrowth after defoliation. *(Hunt. W. F., Field R. T., 1984)*

This study shows that Perennial ryegrass seed has been one of the most profitable large scale arable crops in the long term, where good yields have been maintained. The key factor in producing high yields of quality ryegrass seed is to take a 'specialist crop' approach. By following the principles given in research, specialist growers are achieving consistent seed yields of 1500 kg ha". *(Brown. K. R. et al., 2000)*

In this research *Lolium multiflorum, L. perenne*, reproductive characteristics have been discussed their natural hybrids, and cultivar selections from breeding programs have been used extensively as preferred pasture grasses and as a cover crop in no-tillage cultivated fields, mined-lands reclamation, and short-term cover following chaparral fires. In some cases, they are preferred as an alternative to tillage and herbicide treatment of cultivated crops.

Because they offer a more economical means of weed suppression. *Lolium multiflorum and L. perenne* generally occur in cool, moist sites of waste areas and roadsides. *(Wilken. D. Hannah. L., 1998)*

This research shows that Increasing SOC (Soil Organic Carbon) storage through changes in land use and land management is a low cost and environmentally beneficial way of sequestering substantial amounts of atmospheric CO2. Conversion of cropland to grassland, improved grassland management, and conversion to no-till farming can improve soil carbon sequestration. Although rates of sequestration and total SOC values vary among studies of grassland systems, it seems likely that grassland systems provide valuable carbon storage. *(Rumore. D. et al., 2006)*

Ryegrass can be used as a cover crop to hold soil on construction sites. Quality of vegetative annual ryegrass is very good. , forage should be available for grazing in 6 to 8 weeks or when the grass is 6 inches tall which should occur by mid-November or December 1. Close grazing and rotational grazing will help maintain high quality, improve forage yield, and increase intake of grazing animals. *(Lloyd R. Nelson Texas Agricultural Experiment Station)*

Annual ryegrass *(Lolium multiflorum Lam.)* and perennial ryegrass *(Lolium perenne L.)*. Both species are easy to establish, versatile in how they can be used and adapted on a wide range of soil types. Annual ryegrass is an outstanding winter annual forage grass that is highly productive. It can be grown on heavy, waterlogged soil and will tolerate brief periods of flooding. *(Ball. D. Lacefield. G., 2011)*

Pasture provides a quick way to build carbon for several reasons where perennial species are used, plants are growing continually rather than seasonally Minimal disturbance relative to cropping, No erosion, if well managed. *(Masson .W., 2012)*

The research was taken to investigate winter hardiness of different annual ryegrass *(Lolium multiflorum) varieties.* These annual ryegrass variety trials were blind by design, using a randomized complete block of land with three replications at each site. The only identification used on the varieties in the plots was a number representing each variety. The plots were also

flagged with numbers and data was collected by numbers so that no bias was introduced. A key to the success of annual ryegrass as a cover crop in the Midwest is timely planting later plantings are not always successful. Planting in September is suggested.

Annual ryegrass as a cover crop will enhance several soil properties and improve nutrient cycling which may increase yields. However management, especially timing, is important for success. Soils with a restricted layer, natural or manmade, which limits rooting depth and soil moisture availability have the most to gain from using annual ryegrass as a cover crop. *(Plummer .M. 2008)*

Ryegrass is one of the highest quality forages that can be grown Annual ryegrass is a well-adapted winter annual that can be planted in prepared seedbeds or over seeded onto perennial grass sods for late winter and spring grazing. . If the sites are somewhat poorly drained, ryegrass will be a better choice than the small grains. *(Hancock .W. D., 2014)*

The research shows that Perennial ryegrass is best adapted to cool, moist climates. Perennial ryegrass grows best on fertile, well drained soils but has a wide range of soil adaptability. It is suited for use in soil drainage classes ranging from well drained to poorly drain. It can tolerate long periods of flooding. Perennial grass can tolerate both acidic and alkaline soils. *(Hannaway .D. et al., 1999)*

This study was conducted in the valley of Chagharzai in Bunair district lying in the north Trans-Himalayan moist zone occupying Malakand Division, North Western Frontier Province (NWFP), and Pakistan to determine the nutritive value of locally available free rangeland grasses. *(Sultan .I.S et al., 2008)*

This paper deals first with the importance of range management, then discusses constraints in rangeland development, and finally overviews the recommendations of different expert-forums set-up from time-to-time for the formulation of range policy in Pakistan. The forums gave comprehensive recommendations and suggested creation of an independent range-management agency/ organization vested with authority, responsibility, and accountability, both at federal and provincial levels, for the development of rangelands in Pakistan. However, the implementation of these recommendations is lacking. In addition to the recommendations, other suggestions in the present rangeland scenario have also been discussed for charting detailed and effective rangeland policy in the country. *(Javed .A. et al., 2008)*

This research shows Increase in range dry-matter forage production, species biodiversity, and demonstration to the range-sites. Rangelands must be considered as an ecosystem, rather than just grazing lands. Combined efforts of range livestock management should be used, rather than single range management and improvement work. Watershed areas may be explored for both range livestock development and watershed management. *(Ahmad .S. et al., 2008)*

This study is carried out in Balochistan and it concludes that Utilization of rangelands without any grazing management plan and extraction of vegetation for fuel wood are the major causes of rangeland degradation. Feed scarcity particularly in winter months is the major constraint of small ruminant production. Effective protection of the range area is pre-requisite for the success of any range management program. However, fencing is too expensive, traditional systems for resting some range areas should be encouraged. At least four to six years protection of vegetation from grazing is essential for recovery of heavily grazed rangelands and proper utilization. *(Ahmad .S. et al., 2012)*

The research shows the effect of soil Phosphate on enzymatic activity and plant availability under controlled conditions. The experiment was laid out in a Latin square design, with two blocks, with and without ryegrass. The enzymic activities showed a significant difference in all the soils except Dreghorn soil for alkaline phosphatases and phosphodiesterase.

The enzyme activities generally increased in grassed soils as compared to non-grassed soil with the variable differences to original soils. The yield of roots and tops of ryegrass and P uptake was significantly different amongst the different soils. The dry matter yield of roots was significantly highest in Darvel soil. The total P uptake by the leaves and roots also showed a significant difference between the soils. The highest P concentration of 0.276 and 0.209 % P in leaves and roots was found in Midelney soil. Positive correlation (r = 0.7955) was recorded between the dry matter yield and P uptake by the ryegrass. *(Khan .Q. et al., 2013)*

In this study different cool season forage grass species were evaluated for their performance. *Festuca* and *Lollium* species displayed 100% ground cover followed by *Puccinellia, Poa* and *Elymus* species which exhibited 95, 62.02, 48 and 18.17% ground cover respectively. Festuca

and Lollium species out yielded other species for forage production by producing 4.9 and 2.9 kg/m^2 average fresh green matter repectively. *(Khan .H.Z., et al 2008)*

This study shows that Annual ryegrass can be used for hay, silage, grazing, and soil conservation. It fits into many feed production programs when there is a need for a high producing, high-quality winter annual grass. It is widely adapted, and it has excellent seedling vigor. Keys to success include adequate fertility (especially nitrogen), soil selection, and use of a variety with adequate winter-hardiness and optimum harvest management. Annual ryegrass (Lolium multiflorum Lam.), also called Italian ryegrass, is a high-quality, cool-season, winter annual bunchgrass that is closely related to perennial ryegrass (Lolium perenne L.) *(Lace field .G. et al., 2003)*

The study has shown the result that all the ryegrasses are higher in nutritional value than all of the traditional cool-season grasses at comparable stages of maturity. Some of the testimonials that have received from local farmers indicate that where they have frost seeded ryegrass into a pasture, they see an increase in milk production of 5 lb/cow/day. *(Casler .M. Rand .B. 2003)*

This research shows that Annual ryegrass (Lolium multiflorum), is often chosen as a "living sod" cover crop in vegetable and fruit crops. Its vigorous root system tenaciously holds the soil against erosion while improving soil organic matter levels, increasing water infiltration, and reducing nitrate leaching. Annual ryegrass is considered a good fodder grass, especially when grown with a legume, giving the farmer livestock grazing options. Excellent for increasing organic matter and improving soil structure, for providing erosion control, for quick growth and establishment and is very good for taking up and storing soil N and preventing its loss to leaching, for suppressing weeds, for providing lasting soil residue. *(Valenzuela .H. Smith .J. 2002)*

The study shows that Ryegrass is one of the highest quality forages that can be grown. Providing over 70% TDN and 18% CP if grazed in the late vegetative stage. High quality (56-64% TDN and 10-16% CP) can also Annual Ryegrass (Lolium multiflorum) be expected in the early stages of seed head development. However, quality and palatability of late season forage can be low due to disease (mainly rust) and maturity. Since it can produce such high

quality when properly managed, it often is planted for high quality hay or silage cuttings (usually 1 or 2) in the spring. *(Hancock .W. D. 2014)*

This research shows that Annual ryegrass produces superior yields of hay or pasturage with excellent palatability, a protein content above 20 percent, and other desirable qualities. The new fertilizer technology provides a highly favourable economic return. However, the nitrogen fertilization rates required for highest yields may cause plant nitrate-nitrogen con- centrations that are toxic to livestock. A broadcast application of 80 to 100 pounds nitrogen per acre, in the form of ammonium nitrate, at planting and after each monthly harvest maximized forage or hay yield without causing plant nitrate concentrations to exceed animal tolerance. At this fertilization level, protein content averaged about 20 percent on a dry weight basis. Plant nitrate-nitrogen concentration is not a useful diagnostic guide for maximizing yield. A soil nitrate-nitro- gen concentration of 10 to 20 ppm will ensure a nearly maximal yield at the next cutting, while keeping plant ni- trate-nitrogen at concentrations toler- able for use as a sole- or primary-source livestock feed. This fertilization prac- tice should provide a highly favourable economic return. *(Hagemann .W.R. et al., 2000)*

This studys shows that Perennial ryegrass has a wide range of adaptability to soils, but thrives best on dark rich soils. It will withstand fairly wet soils with reasonably good surface drainage. It will not tolerate standing water for extended periods of time. It grows on soils that have a pH between 5 and 8 with best yields on soils with pH between 6 (slightly acidic) to 7 (neutral). Perennial ryegrass should be restricted to regions having mild climates with moderate temperature and higher moisture or irrigated regions of the Intermountain and Rocky Mountain West. It does not withstand hot, dry weather or severe winters. To produce high yields, perennial ryegrass requires 30 to 50 inches of rainfall or equivalent supplemental full irrigation annually. *(Britton & Brown 1996)*

In this research the results of investigations and assessment of air pollution by cadmium, lead, and arsenic using Italian rye grass are presented in this paper. The experiment was carried out in 2011 growing season. *Lolium multiflorum L*, Lema exhibits several properties useful for active biomonitoring of air pollution. Plants were exposed at sites varying in environmental characteristics. High cadmium and lead concentration of elements in certain exposure series. The highest arsenic concentrations were observed in the first exposure series, while the highest lead concentrations were observed during the second series. Comparison of trace

element concentrations at exposure sites to the control site revealed that comparable levels occurred in the sites. This was an effect of high cadmium and lead levels at city sites, and arsenic at rural site. The lowest level of measured trace elements was observed at an exposure site located 15km from rural area. *(Borowiak .k. et al., 2014)*

Research was conducted to determine the effects of temperature and the plant growth regulator PGR IV on germination and seedling growth of six turfgrass species. Seeds of each species were placed in paper germination pouches and germinated in an incubator at 10, 15, 20, 25, or 30 oC for a period of 21 days. Duplicate samples were treated with PGR IV, a commercially available plant growth regulator consisting of a proprietary blend of indole butyric acid and gibberellic acid and a fermentation broth. PGR IV had no influence on the percentage of germination of any species but did increase root and shoot dry weight in tall fescue and perennial ryegrass. *(Longer .D.E. et al., 1999)*

CHAPTER 3

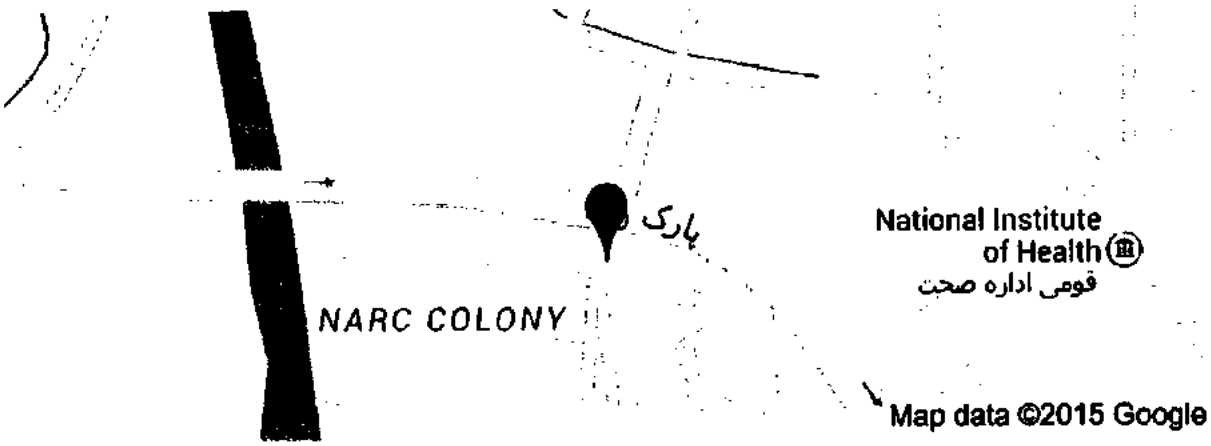
MATERIALS AND METHODS

Material and Method

National Agricultural Research Centre (NARC), Islamabad established in 1984, is the largest research centre of the Pakistan Agricultural Research Council (PARC). NARC, with a total land area of approximately 1400 acres, is located near Rawal Lake, six kilometres south-east of Islamabad

Research was conducted at RRI NARC Islamabad. The metropolitan area of Islamabad lies between 72° 45' and 73° 30' longitude and 33° 30' and 33° 50' N latitude. National Agricultural Research Centre (NARC), Islamabad established in 1984, is the largest research centre of the Pakistan Agricultural Research Council (PARC). NARC, with a total land area of approximately 1400 acres, is located near Rawal Lake, six kilometres south-east of Islamabad.

Aim of the study was to investigate different varieties of rye grass *(Lolium multilorum)* its density and their impact on soil for soil protection, soil binding and its yield by studying different parameters of climate on its growth these varieties (Rye 1 Accelerate, Rye 2 Makkhan, Rye 3 Emmerson) were imported from Australia. Different tests were conducted for comparison of yield, productivity and quality after their introduction into Islamabad environment.



3.1 Calculating percent cover

Calculation of percent cover shows the retention of soil that was calculated by measurement of no. of plants/square meter and calculating no of tillers/plant. The more the percent cover (density) more the soil protection and that leads to less barren area. In this way the soil protection tendency in comparison to different rye specie was calculated.

3.2 Quality of Different Rye grasses.

The quality of rye grasses *(Lolium multiflorum)* was measured for the sake of livelihood and life stock development in the range areas.

3.3 Field preparation and sowing

For sowing, the land was prepared by a disc plough followed by a cultivator plough. The plot size was 5m x 10m. Sowing was done with the help of a hand pulled drill with rows placed 50 cm apart. The seed rate was kept at 5 kg per hectare. Final seed rate was adjusted taking into consideration the germination percentage. To minimise the chance of error; three replications of each treatment were sown. Days to flowering and days to maturity was recorded. There were 3 replications in randomized complete blocked design.

3.4 Biomass yield

Fresh matter yield was collected by ADC quadrat. All plants within one meter square were clipped at a stubble height of 15 cm were clipped and weighed to find out fresh matter. Samples were placed in an oven maintained at 80°C for 72 hours to get dry matter yield.

For measuring dry matter percentage formula used is:

DM = Weight of dried sample/weight of fresh sample x 100

3.5 Seed Germination of Ryegrass

Rye grass seed germination test was conducted in the laboratory petri dishes were lined with Wahttman filter paper uniformly 100 seed of each variety was placed in separate petri dishes. Germinated seed was counted daily after seven days total seed germination was calculated. The study was conducted with 3 replications

1. This present research study was on the Rye grass *(Lolium multiflorum)* varieties; one local and other three were imported from Australia.
2. Different tests were conducted for comparison of yield, productivity and quality of Rye grass after their introduction into Islamabad environment.
3. Varieties were sown namely Accelerate, Makhan, Emerson and local Rye one.

CHAPTER 4

RESULT AND DISCUSSION

Result and Discussion

The aim of study is to investigate rye grass *(Lolium multiflorum)* varieties by assessing the quality of rye grass *(Lolium multiflorum)* in terms of calculating the rate of seed germination at different stages and by calculating its yield, productivity and quality of rye grass *(Lolium multiflorum)* in comparison of other varieties, its impact on soil erosion, soil binding by studying different factors like temperature and rainfall.

4.1 Yield Parameters

4.1.1 Germination Percentage

Seed germination is influenced by oxygen availability, water, and proper temperature. For optimal germination, most grass species also require exposure to light. Both cool- and warm-season grass species have cardinal germination temperatures. These values are determined for each species by conducting germination tests over a range of temperatures, spaced at small temperature intervals. *(Longer .D.E., et all 1999)*

The more the percent cover of a grass more the protection against the soil erosion different grasses have tendency of spreading roots and shoots at different percent. The number of plants per square meter represent the density of plants. *(Plumer. M. et al., 2013)*

The present study was designed to examine the germination percentages of seed kept for different time periods and their reaction under local ecological settings.

Germination percentage was calculated with 100 seeds of each grass in 3 replications. Accelerate had presented germination percentage of 56.67%.Makkhan showed germination percentage of 54.67% Emmerson showed 60.33% Rye One showed 65.33%. Henceforth the Germination percentage of Rye one was improved than other three varieties under main conditions. (Table 4.1, Figure 4.1)

Table 4.1: Germination Percentage (%) of four grasses.

Grass	Total Seeds	Total Germination	Percentage (%)
Accelerate	100	56.67	56.67
Makkhan	100	54.67	54.67
Emmerson	100	60.33	60.33
Rye One	100	65.33	65.33

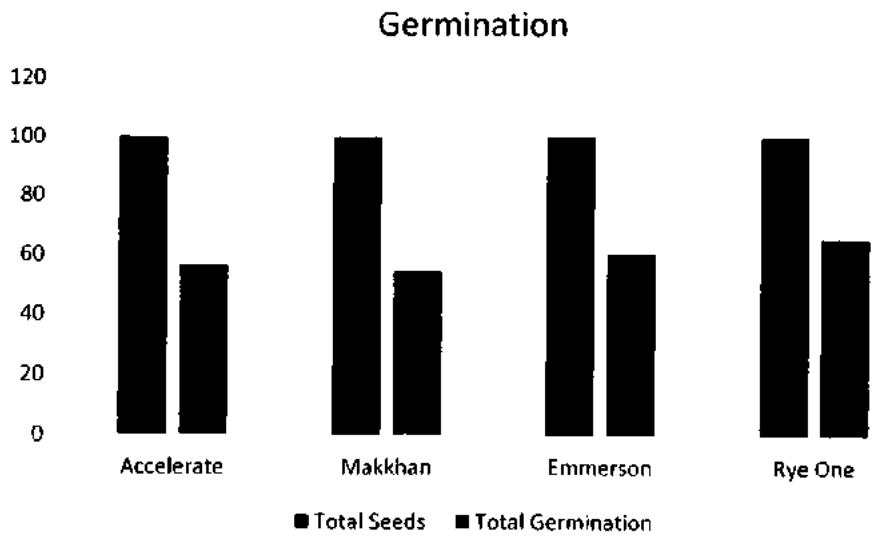


Figure 4.1: Germination percentage of four grasses

4.2 Fresh and Dry Weight at Vegetative Growth

Following tables from (4.2a-4.2d) show grasses *(Lolium multiflorum)* in three replications of each variety at Vegetative Growth, in which Fresh weight, Dry weight and Plant height is recorded.

Table 4.2a

Variety (Accelerate)	Fresh Weight(tons)	Dry Weight(tons)	Height(cm)
R_1	26	14	76
R_2	21	10	73
R_3	20	9	78

Table 4.2b

Variety (Makkhan)	Fresh Weight(tons)	Dry Weight(tons)	Height(cm)
R_1	36	18	90
R_2	42	24	80
R_3	38	17	85

Table 4.2c

Variety (Emmerson)	Fresh Weight(tons)	Dry Weight(tons)	Height(cm)
R_1	20	11	40
R_2	29	18	68
R_3	24	12	60

Table 4.2d

Variety (Rye One)	Fresh Weight(tons)	Dry Weight(tons)	Height(cm)
R_1	18	8	100
R_2	31	17	102
R_3	28	14	99

4.3 Fresh and Dry Weight at Flowering Stage

Tables below from (4.3a-4.3d) show four varieties of grasses *(Lolium multiflorum)* in three replications at flowering stage, in which Fresh weight, Dry weight and Plant height is noted.

Table 4.3a

Variety (Accelerate)	Fresh Weight(tons)	Dry Weight(tons)	Height(cm)
R_1	37	15	105
R_2	65	28	85
R_3	46	20	90

Table 4.3b

Variety (Makkhan)	Fresh Weight(tons)	Dry Weight(tons)	Height(cm)
R_1	63	26	108
R_2	70	29	120
R_3	58	24	100

Table 4.3c

Variety (Emmerson)	Fresh Weight(tons)	Dry Weight(tons)	Height(cm)
R_1	34	13	60
R_2	91	38	90
R_3	45	18	80

Table 4.3d

Variety (Rye One)	Fresh Weight(tons)	Dry Weight(tons)	Height(cm)
R_1	33	15	150
R_2	35	17	130
R_3	30	16	125

4.4 Fresh and Dry Weight at Maturity

Following tables from (4.4a-4.4d) show grasses *(Lolium multiflorum)* in three replications of each variety at Maturity stage, in these tables Fresh weight, Dry weight and Plant height is recorded.

Table 4.4a

Variety (Accelerate)	Fresh Weight(tons)	Dry Weight(tons)	Height(cm)
R_1	15	7	95
R_2	12	5	85
R_3	16	8	98

Table 4.4b

Variety (Makkhan)	Fresh Weight(tons)	Dry Weight(tons)	Height(cm)
R_1	14	6	105
R_2	14	6	99
R_3	17	8	100

Table 4.4c

Variety (Emmerson)	Fresh Weight(tons)	Dry Weight(tons)	Height(cm)
R_1	15	7	92
R_2	11	6	80
R_3	13	6	90

Table 4.4d

Variety (Emmerson)	Fresh Weight(tons)	Dry Weight(tons)	Height(cm)
R_1	5	3	103
R_2	6	4	95
R_3	7	4	105

4.5 Dry Weight, Fresh Weight and Plant Height

The plant growth can be measured through characteristics like height, tillering, branching, and bearing new leaves. These characters are ultimately translated into biomass produced in a field. The fresh weight includes moisture contents while dry weight is without moisture. Unless water contents or salinity/sodicity are the investigating factors, there is no significant variation observed in these two parameters *(Arshadullah, 2010).*

Harvesting time is the most important factor affecting the plant physiology and expression of the yield potential of a crop as the dry matter production and partitioning depends upon the stage of the crop growth at harvesting. *(Shoaib et al 2013).*

4.5.1 Mean Value at Vegetative Growth

In current study, the mean of dry weight among four varieties of *(Lolium multiflorum)* at vegetative growth in table 4.5.1 is exhibited. In followed table among *lolium* varieties variety one is Accelerate, 2 is Makkhan, 3 is Emmerson and 4th is Rye one. The table shows that variety 2 Makkhan had more dry weight of 19.67 whereas all other three varieties have different means. Result shows significance as means of all varieties vary, have difference in their mean and are statistically significant.

In table 4.5.1 fresh weight at vegetative growth among *lolium* species variety 2 Makkhan had greater weight than all other three varieties it weighs 38.67 as it has different mean that shows significance. There is variation between mean of different groups.

The mean data of height in table 4.5.1 showed that variety 4 Rye one had height of 100.33 cm whereas variety 2 Makkhan had height of 85cm, variety 1 Accelerate at 75cm and variety 3 Emmerson had height of 56cm.

Table 4.5.1

Variety	Dry Weight	Fresh weight	Plant Height
Accelerate	11.00 B	22.3 B	75 B
Makkhan	19.67 A	38.67 A	85 AB
Emmerson	13.67 AB	24.33 B	56 C
Rye one	13.00 B	25.67 B	100.33 A
LSD(a=0.01,0.05)	6.43	8.40	17.06

Means that follow same letters indicate no significance

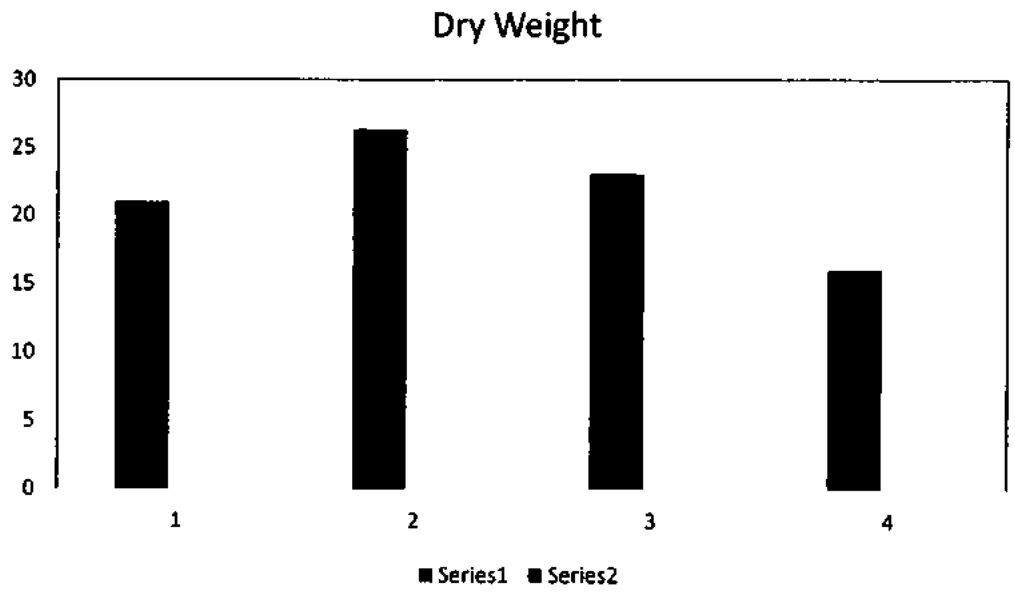


Figure 4.5.2 Dry Weight of 4 varieties at Vegetative stage

In the above table we have *lolium* varieties on x axis and weight on y axis that shows in all four varieties of *lolium* variety 2 Makkhan had shown great result.

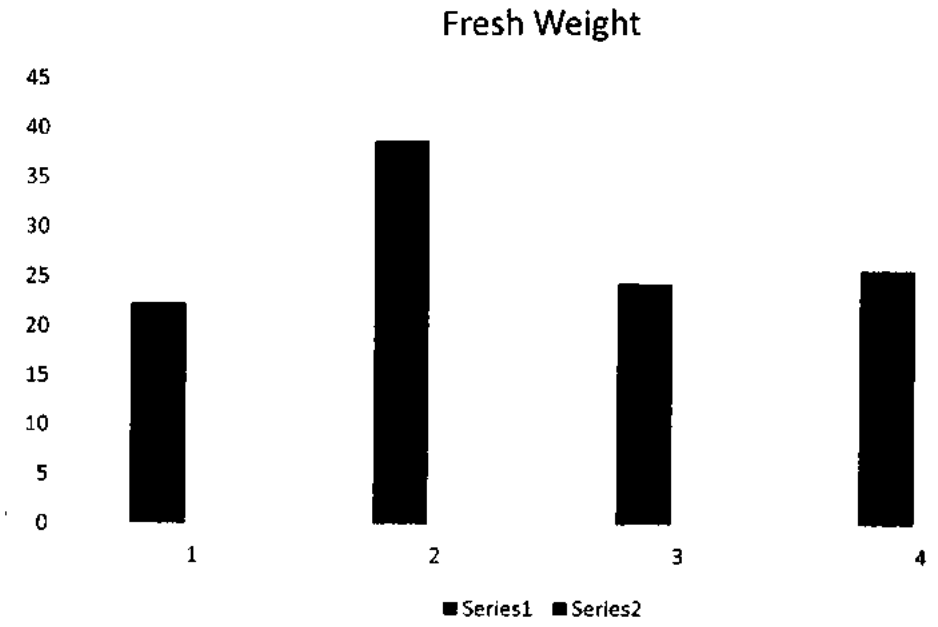


Figure 4.5.3 Fresh Weight of 4 varieties at Vegetative stage

The graph shows fresh weight of four varieties. On x axis are varieties and y axis shows fresh weight of four varieties. In all *Lolium* species variety 2 Makkhan had presented more fresh weight

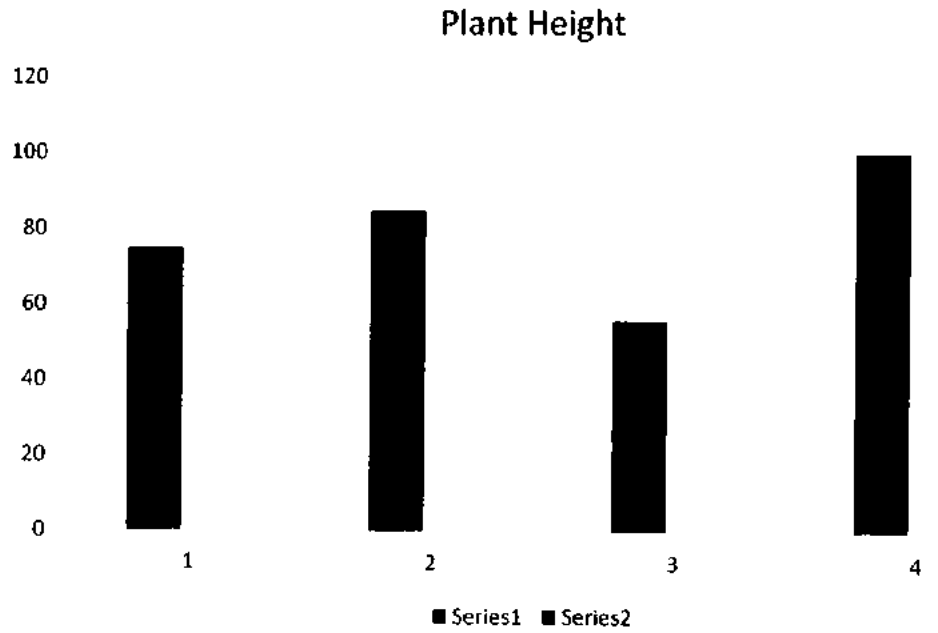


Figure 4.5.4 Plant weight of 4 Varieties at Vegetative stage

The above graph shows plants height of four varieties in which variety 4 Rye one had outcompeted other varieties.

4.6 Mean Value at Flowering Stage

The following table 4.6.1 shows mean value of four varieties of *Lolium multilflorum at* flowering stage in which dry weight, fresh weight and plant height is recorded. At different growth levels changing performances of four varieties were seen. Among four varieties in dry weight all varieties of *Lolium multilorum* have slightly difference as all have given same variable which shows no significance. In fresh weight of *lolium* specie variety 2 Makkhan weighed more than other varieties and had better result. In plant height variety 4 Rye one showed great result and it had height of 135cm.

Table 4.6.1

Variety	Dry Weight	Fresh weight	Plant Height
Accelerate	21.00 A	49.33 AB	91.67 BC
Makkhan	26.33 A	63.67 A	109.33 AB
Emmerson	23.00 A	56.67 AB	76.67 C
Rye one	16.00 A	31.33 B	135.00 A
LSD(a=0.01,0.05)	11.35	25.75	28.47

Means that follow same letters indicate no significance

The following figure 4.6.2 shows graph of dry weight of four varieties in which variety 2 Makkhan showed better result. On x axis we have varieties and on y axis we have dry weight.

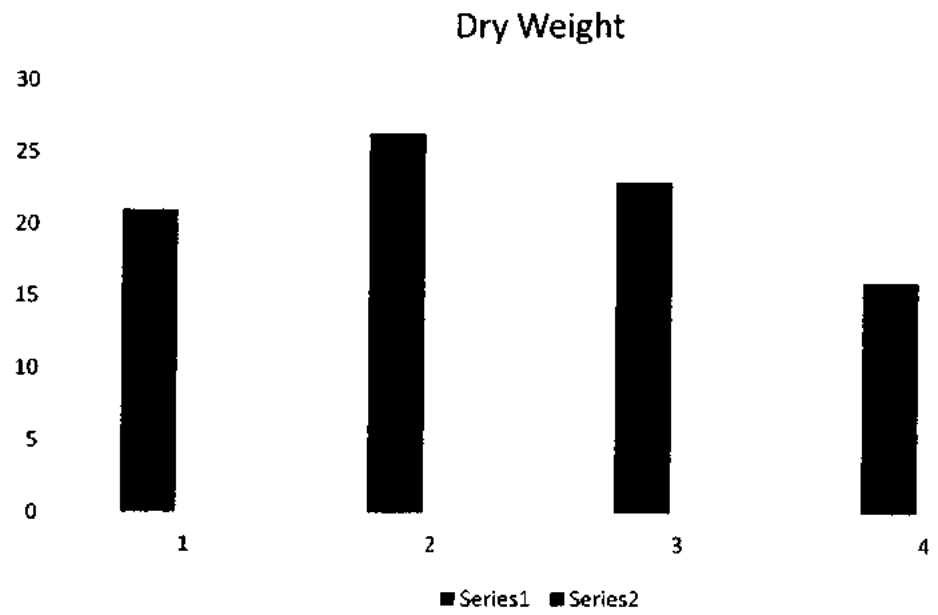


Figure 4.6.2 Dry Weight of Four varieties at flowering stage

Following figure 4.6.3 shows fresh weight of four grass *(Lolium)* varieties in which Variety 2 Makkhan showed good result.

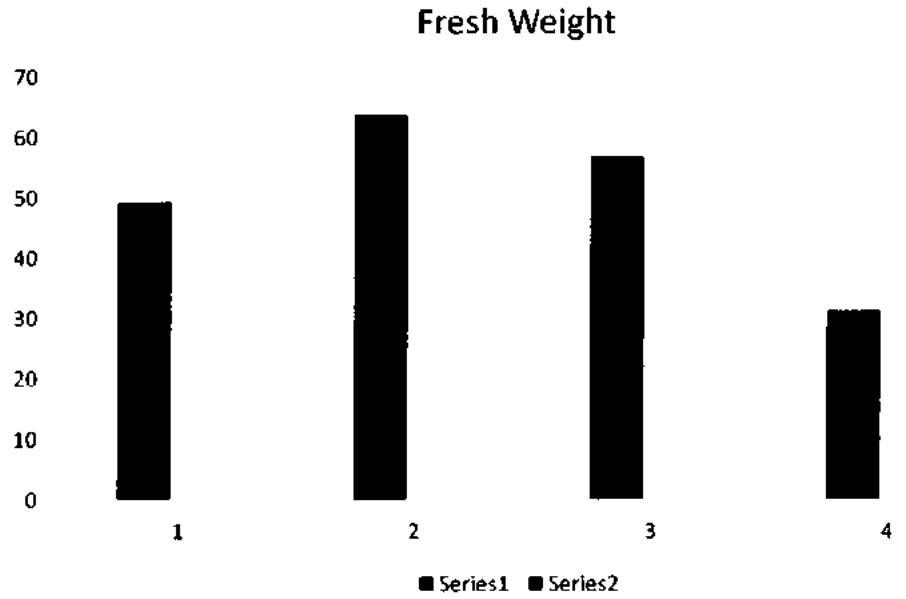


Figure 4.6.3 Fresh Weight of 4 Grasses at flowering stage

The figure 4.6.4 below shows height of four grass *lolium* varieties among these four varieties variety 4 Rye one showed enhanced result.

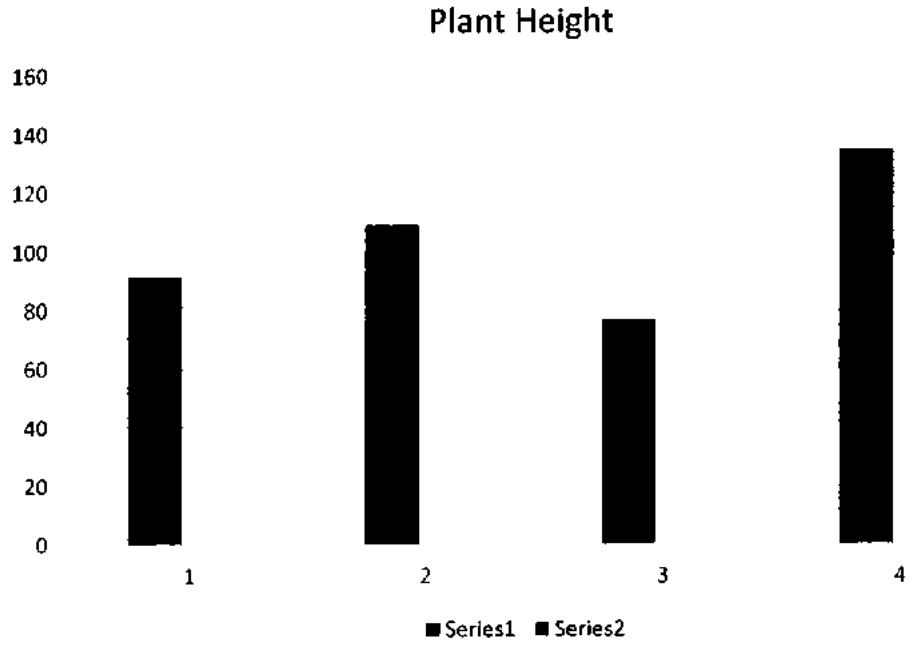


Figure 4.6.4 Height of four Varieties at flowering stage

4.7 Mean Value at Maturity Stage

Following table 4.7.1 contained mean value of fresh weight, dry weight and plant height of four varieties of *lolium multiflorum* at Maturity stage. At different growth phases, fluctuating performances of four varieties of *lolium multiflorum* were seen. Among all four varieties at Maturity stage variety 3 Emmerson had given better result in terms of fresh weight rest of three varieties had shown almost similar results. In dry weight variety 2 Makkhan showed good result. In terms of plant height within four varieties of *lolium multiflorum* the best height of variety 2 Makkhan is recorded as it is of 101.33cm.

Table 4.7.1

Means that follow same letters indicate no significance

Variety	Dry Weight	Fresh weight	Plant Height
Accelerate	6.67 A	14.33 A	92.67 B
Makkhan	6.67 A	15.00 A	101.33 A
Emmerson	6.33 A	13.00 A	87.33 B
Rye one	3.67 B	6.00 B	101.00 A
LSD(a=0.01,0.05)	1.91	2.83	5.61

The following graph 4.7.2 presents mean of dry weight of four varieties of *lolium multiflorum* at Maturity stage in which result of variety Accelerate, Makkhan, Emmerson has shown almost same but the slight difference shows that variety 2 Makkhan showed better result.

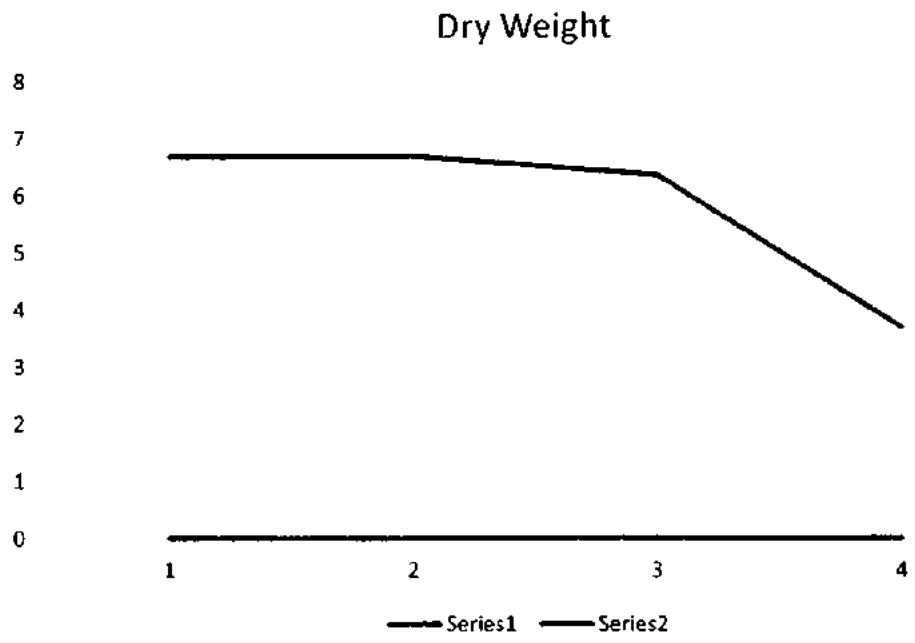


Figure 4.7.2 Dry Weight of 4 varieties at Maturity

Following graph 4.7.3 shows mean of fresh weight of four varieties at maturity stage in which variety 2 Makkhan showed better result. On x axis we have all four varieties of *lolium multiflorum* and on y axis we have fresh weight.

Figure 4.7.3 Fresh weight of 4 varieties at Maturity

Figure 4.7.4 shows plant height of four varieties of *lolium multiflorum* at maturity stage in which variety 4 Rye one showed good result and Variety 2 Makkhan is close to rye one which shows both varieties have better result.

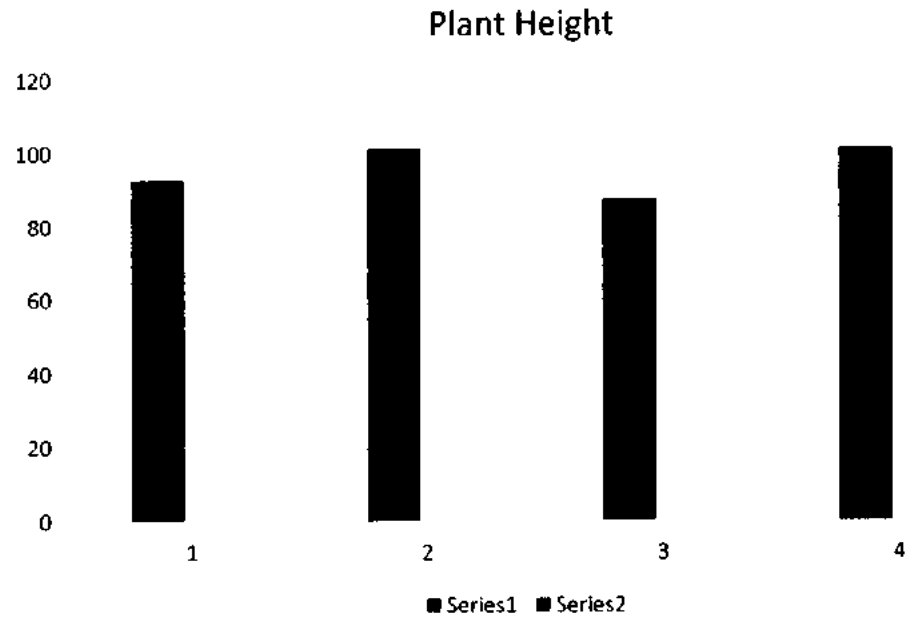


Figure 4.7.4 Plant Height of 4 Varieties at Maturity stage

4.8 Mean Value at Germination

Table 4.8.1 shows mean value of all four varieties of *lolium multiflorum* at germination stage. From results it is clear that variety 4 Rye one showed better result next to that is variety 3 Emmerson and then variety 2 Makkhan and variety 1 Accelerate.

Table 4.8.1

Variety	Mean
Accelerate	56.67 C
Makkhan	54.67 C
Emmerson	60.33 B
Rye one	65.33 A
LSD(a=0.01,0.05)	3.48

Following figure 4.8.2 shows mean value of four varieties of *lolium* at germination stage.

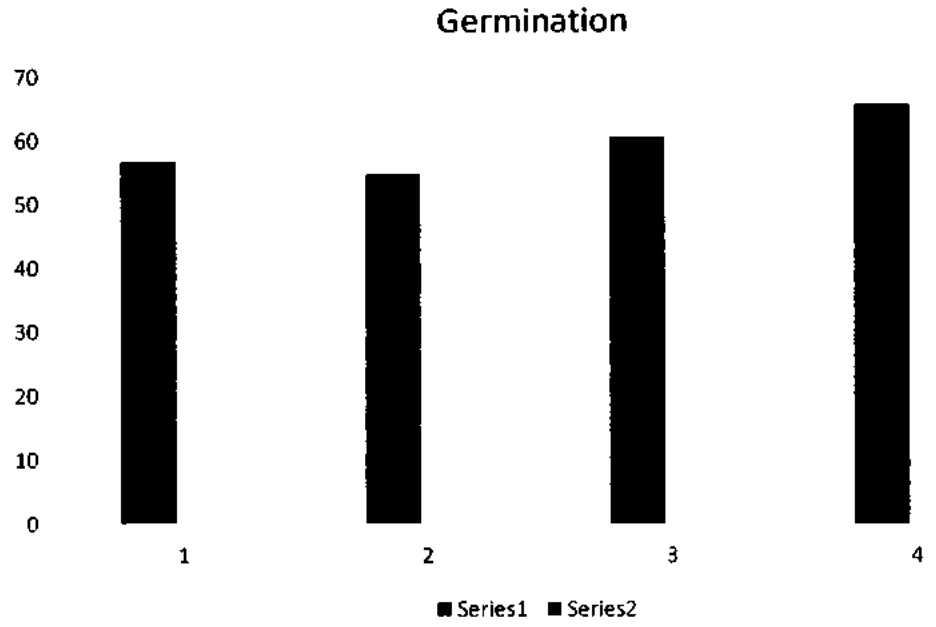


Figure 4.8.2 Mean value of 4 varieties at Germination stage

5 Analysis of Variance at Vegetative Growth

From F test analysis of variance we can conclude that F value/analysis of variance indicates variation among varieties of *lolium multiflorum* in dry weight, fresh weight and plant height at vegetative growth as their probability values are less than 10%, 5%, 1% respectively.

Table5a

S.O.V	DF	Dry Weight	Fresh Weight	Plant Height
Rep	2			
Variety	3	4.03***	9.30*	14.13**
Error	6			
Total	11			

*** = Significant value 10% a

* = Significant value 5% a

**= Significant value 1% a

NS= non-significant

5.1 Analysis of Variance at Flowering Stage

Analysis of variance at flowering stage of *lolium multiflorum* shows significant result in fresh weight and in plant height at flowering stage.

Table 5.1.1

S.O.V	DF	Dry Weight	Fresh Weight	Plant Height
Rep	2			
Variety	3	1.74 NS	3.49**	9.29**
Error	6			
Total	11			

*** = Significant value 10% a

* = Significant value 5% a

**= Significant value 1% a

NS= non-significant

5.2 Analysis of Variance at Maturity Stage

Table 5.2.1 shows analysis of variance of *lolium* varieties at maturity stage. F test tells us the overall significance. The result shows that f test is significant at 1% and 5% alpha.

Table 5.2.1

S.O.V	DF	Dry Weight	Fresh Weight	Plant Height
Rep	2			
Variety	3	6.91**	25.71*	17.62**
Error	6			
Total	11			

*** = Significant value 10% a

* = Significant value 5% a

**= Significant value 1% a

NS= non-significant

6 Coefficient of Variation

In table 6.1 Co efficient of variation tells us consisted performance. The less CV we have the best result we get within different varieties. Among all varieties of *lolium multiflorum* in terms of dry weight variety 2 Makkhan had shown improved performance. In relation to fresh weight again variety 2 Makkhan showed great result and with respect to plant height among all varieties of *lolium* variety 2 Makkhan showed good result.

Table 6.1

Varieties	DW	FW	PH
Accelerate	24.052	14.394	3.3259
Makkhan	19.251	7.9010	5.8824
Emerson	27.702	18.531	25.754
Rye One	35.251	26.520	1.5225

7 Metecrological Data

Following table 7.1 shows the meteorological data of Narc in which the present research was taken. In this table minimum temperature, maximum temperature and rainfall data is detailed. By this we get to know that what affect these all parameters have on all four varieties of grasses. The data is of one year from October 2014 till October 2015 in which we can see variation of temperature and rainfall in different months.

Table 7a

Year 2014-2015	Min Temp °C	Max Temp °C	Rainfall
October	15	28	38.73
November	6.90	24.6	4.74
December	2.77	20.0	0
January	3.48	23.0	25.98
February	7.46	19.4	95.21
March	10.00	22.0	306.53
April	15.77	27.5	159.07
May	18.19	34.1	33.67
June	21.30	36.1	24.96
July	24.06	32.9	245.21
August	22.71	33.3	214.15
September	20.93	31.5	337.45
October	16	27	35.63

7.1 Regression Analysis (Min Temp)

In table 7.1.1 explains about regression analysis in which minimum temperature is dependent variable and time is independent. The results shows positive affect of independent variable on dependent variable with increase in one unit Increasing trend shows that with the passage of time minimum temperature has increased.

R-sq = 54.4% shows that 54% of variation has been explained by independent variable than dependant variable therefore the model is said to be satisfactory

Regression Equation Y= a + bx

Y= 4.45 + 1.39 year

Table 7.1.1

Predictor	Coefficient	T	P
Constant	4.447	1.46***	0.173
Year	1.3930	3.62**	0.004

*** = Significant value 10% a

* = Significant value 5% a

**= Significant value 1% a

NS= non-significant

7.2. Analysis of Variance

F test shows that the result is significant at 1 % alpha.

Table 7.2.2

Source	DF	F	P
Regression	1	13.11**	0.004

7.3 Regression Analysis (Max Temp)

Table 7.3.1 enlightens about regression analysis in which maximum temperature is dependent variable and time is independent variable. The results demonstrate positive outcome of independent variable on dependent variable with rise in one unit.

R-SQ =38.8% indicates that 38.8% of variation has been clarified by independent variable than dependant variable so the model is said to be satisfactory.

Regression Equation Y= a + bx

Y= 21.6 + 0.862 year

Table 7.3.1

Predictor	Coefficient	T	P
Constant	21.612	7.83	0.000
Year	0.8621	2.48**	0.031

*** = Significant value 10% a

* = Significant value 5% a

**= Significant value 1% a

NS= non-significant

7.3.1 Analysis of Variance

F test demonstrates that the result is significant at 1% alpha.

Table 7.3.1

Source	DF	F	P
Regression	1	6.15**	0.031

7.4 Regression Analysis (Rain Fall)

Table 7.4.1 enlightens about regression analysis in which rain is dependent variable and time is independent variable. The results shows positive response of independent variable on dependent variable.

R-sq = 23.6% % specifies that 23.6% of variation has been explained by independent variable than dependant variable so the model is said to be satisfactory.

Regression Equation Y= a + bx

Y (Rain fall) = 11.4 +15.1 year

Table 7.4.1

Predictor	Coefficient	T	P
Constant	11.41	0.18**	0.864
Year	15.087	1.84**	0.092

*** = Significant value 10% a

* = Significant value 5% a

**= Significant value 1% a

NS= non-significant

7.4.2 Analysis of Variance

F test shows significant result at 1% alpha.

Table 7.4.2

Source	DF	F	P
Regression	1	3.40**	0.092

Means that follow same letters indicate no significance

8 Mean Data of Number of tillers, Percentage of Cover, Number of plants per square meter.

Table 8.1 explains that there is no variation among varieties of *lolium multiflorum* with respect to percentage, so the result is nonsignificant as it doesn't have variation in other words they are associating with each other. Among four varieties of *lolium multiflorum* variety 2 Makkhan and variety 1 Accelerate has shown positive result with respect to number of tillers, more the number of tillers more area is covered and there will be more infiltration and less surface runoff. In number of plants per square meter variety 2 Makkhan and variety 4 Rye one has shown good result.

Table8.1

Variety	No of Tillers	Percentage of Cover	No of Plants per Sq meter
1	14.33 C	83 A	122.67 BC
2	21.33 A	89 A	151.67 A
3	17.33 B	83 A	138.00 AB
4	18.33 B	85 A	114 C
LSD (a=0.01-0.05)	2.23	8.25	18.04

8.1 Analysis of Variance of Number of tillers

Table 8.1.1 demonstrates analysis of variance of number of tillers. F test states us the overall significance. The result shows that f test is significant at 1% and 5% alpha.

Table 8.1.1

Source	DF	F	P
Rep	2		
Variety	3	20.00**	0.0016
Error	6		
Total	11		

*** = Significant value 10% a

* = Significant value 5% a

**= Significant value 1% a

NS= non-significant

8.2 Analysis of Variance of Percentage Cover

Table 8.2.1 validates analysis of variance of percentage of cover. F test states us the overall significance. The result shows that f test is significant at 1% and 5% alpha

Table 8.2.1

Source	DF	F	P
Rep	2		
Variety	3	1.27*	0.366
Error	6		
Total	11		

*** = Significant value 10% a

* = Significant value 5% a

**= Significant value 1% a

NS= non-significant

8.3 Analysis of Variance of Number of Plants per Square Meter

Table 8.3.1 validates analysis of variance of plants per square meter. F test states us the overall significance. The result shows that f test is significant at 1% and 5% alpha.

Table8.3.1

Source	DF	F	P
Rep	2		
Variety	3	10.22**	0.009
Error	6		
Total	11		

*** = Significant value 10% a

* = Significant value 5% a

**= Significant value 1% a

NS= non-significant

Conclusion and Recommendations

It is concluded from the present research work that significance of grass should not be ignored or underestimated. In its place the variety of grasses ought to be acknowledged. As global warming is growing, global pollution is resulting in worsening of natural resources and it is need of the hour to discover such resources which are more adapted to changing climatic conditions. The present study is built on this issue. Different exotic and indigenous varieties of rye grass were verified in terms of quality, yield and environmental considerations. One local and three other varieties were imported from Australia. These are Accelerate, Makkhan, Emmerson and Rye one. Among these four varieties the variety Makkhan had highest fresh and dry matter. It executed better results than other three varieties as it has long roots and is hardy grass that is good for soil, with increase and decrease in temperature this variety has shown better results and is best to moist environment. With long roots it increases infiltration and decreases runoff. The more the percent cover of a grass more the fortification contrary to the soil erosion. The number of plants per square meter signify the thickness of plants. It is suggested to policy makers to sow this grass in rangeland areas and in areas with polluted soil to control soil erosion and to promote awareness.

References

Afzal, J., Ahmad, M., Begum, I. (2008). Vision for Development of Range Lands in Pakistan *Rangeland Research Institute (RRI), NARC, Islamabad-45500, Pakistan. Pulses Programme, Crop Sciences Institute (CSI)* Vol.**14**

Afzal, J.Afzal, M. andAsghar, M. 2001. Resource Analysis of Sindh Ibex (Capra aegagrus) Habitat at Tobattee Mountain, District Kalat, Balochistan. Technical Report. World Wide Fund for NaturePakistan,Quetta. 36pp

Ahmad, S., Afzal, M., Jasra, W. A., Islam, M., Aslam, S., Imail, M., Koukab, S. (2008).

Ahmad, S., Islam, M., Mirza, N.S. (2012). Range Land Degradation and Management Approaches in Baluchistan, Pakistan Pak. J. Bot., **44**: 127-136

Akmal .M. Farid. U., Asim. M., and Farhatullah *Growth comparison of exotic species for green forage* Pak. J. Bot., 43(3): 1557-1561, 2011

Arid Zone Research Centre, Quetta. Pakistan Agricultural Research Council, Islamabad. International Centre for Integrated Mountain Development Nepal. Vol.**14**

Arshadullah, M., Afzal, J., Anwar, M., Mirza, N. S., Rasheed, M. Forage Production and Nutritional Quality of Grasses in Mesic Climate of Pothowar Plateau Rawalpindi *The Journal of Animal & Plant Sciences*, **22**(3): 2012 Page 781-784

Borowiak, K., Zbierska, J., Baralkiewicz, D., Hanc, A., Budka, A., Kayzer, D., Kawala, A. (2014). *Bio monitoring of Air Pollution by Trace Elements suing Italian Ryegrass9 Lollium Multiflorum L) Pol.J. Environ. Stud,* Vol **23**

Brown .K. R., Lill .J. Mc Cartin, *Rye grass seed crops.*

Casler, M., Rand, B. (1995). Annual (Italian) Ryegrass Frost Seeding *Trial University of Wisconsin-Madison Department of Agronomy Spooner Agricultural Research Station*

Fisher, b. (2006). Seeding of Annual Ryegrass as a Midwest Crop *Proceedings of the 2006 Indiana CCA Conference, Indianapolis, IN*

Hannaway .D., Fransen .S., Cropper .J., Chaney .M., Halse .R., Hart .J., *Perennial rye grass lolium perenne* April 1999

Hasnain, U.H., Usmani, H.R. (2006). Livestock of Pakistan.

Hunt .F. W., Field .R. T., *Growth characteristic of perennial rye grass*

Khan, H.Z., Majeed, A., Yaqoob, S., Tocee, U.A., Aslam, Z. (2008). Comparative Studies on Winter Range Grasses for their Forage Production *Pakistan Journal of Science*

Khan, Q. U., Flower, H.T., Sanaullah. (2013). Influence of Soil Phosphorus on Enzyme Activity, Rye grass yield and Extractable Phosphate *The Journal of Animal and Plant Sciences,* 23(1):2013, Page:222-226

Lacefield, G., Collins, M., Henning, J., Phillips, T., Rasnake, M., Spitaleri, R., Grigson, D., Turner, K. (2003). Annual Ryegrass *University of Kentucky College of Agriculture*

Lloyd R. Nelson Annual Ryegrass *Small Grains & Ryegrass Breeder Texas Agricultural Experiment Station*

Mike Plumer *Annual Ryegrass Variety Report* June 2008

Oregon growth quality seed perennial rye grass *Oregon State University Extention Service, PNW 501, April 1999*

Plummer, M., Mellby .M. I., Towery. D. (2013). Annual Ryegrass Cover Crop Management for Corn and Soybean Production.

Rumore. D., Sulzman .E., Young .W., *The potential for carbon sequestration in grass seed cropping systems in western Oregon: the state of the science as reported in the literature as of December*, 2006

S.M Griffith, J,H Davis., G.M Banowetz *Soil Budget for annual and perennial ryegrass grown for seed* (2004)'

Sheikh, M. I., Pasha, K.M., William, S.V., Raza, Q.S., Khan, A.S. Environmental Geology of the Islamabad-Rawalpindi Area, Northern Pakistan.

Shoaib .M., Ayub .M., Zamir .S.I.M., Akhtar .J.M., *Dry Matter Yield of Oat-Egyptian Clover Mixture under Varying Proportions and Different Growth Stages of Oat INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY*

Sultan .I. J., Inamurahim ,Yaqoob . M., Nawaz .H., *NUTRITIVE VALUE OF FREE RANGELAND GRASSES OF NORTHERN GRASSLANDS OF PAKISTAN* Pak. J. Bot., 40(1): 249-258, 2008.

Valenzuela, H., Smith, J. (2002). Annual Ryegrass *Departments of Tropical Plant and Soil Sciences and Natural Resources and Environmental Management.*Vol **60**

ANNEXURE