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INFLUENCE OF SEEDING RATES AND NITROGEN APPLICATION ON GROWTH, FORAGE YIELD AND ITS COMPONENTS OF FIVE VETCH (*VICIA SATIVA*) VARIETIES UNDER RAINFED CONDITION OF SULAIMANI DISTRICT-IRAQ

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Abstract:

This study was conducted to evaluate the influence of seeding rates and nitrogen application on the growth, forage yield, and its components of different vetch varieties under rainfed conditions of sulaimani region during the growing season of 2020-2021. The field experiment was conducted in a split-split plot layout arrangement with a randomized complete block design (RCBD) with three replications. The main plots were fertilizer applications (no fertilization 0Kg N/ha and fertilization 40Kg N/ha), and subplots consisting of five varieties of vetch obtained from Agricultural Research Centre-Sulaimania were (V1(Morrd), V2 (Rook), V3 (Excel), V4 (Clima), and V5 (Namoi)), while sub-sub plots were two different seeding rates (40 Kg/ ha and 60 Kg/ha). The result of this investigation showed that the application of nitrogen fertilizer caused to increase in some growth traits of vetch such as no. of branches. plant^{-1}, no. of leaves. plant^{-1}, the weight of leaves. plant^{-1} and root length, green forage yield, dry forage yield, dry matter%, fresh leaf%, fresh leaves/stem ratio, dry leaf%, and dry leaves/stem ratio. Variety 2 (Rook) gave the highest value for most growth traits, green forage yield, and dry forage yield, but the lowest dry matter% was obtained by this variety, and variety 1 (Moord) was the best among other varieties for forage yield components such as fresh leaf%, fresh leaves/stem ratio, dry leaf%, and dry leaves/stem ratio. By increasing the seeding rate plant height, and weight of leaves. plant^{-1}, green forage yield, dry forage yield, fresh stem%, and dry stem% were increased but other growth traits and dry matter% decreased. Cluster analysis results indicate the presence of high variability based on agro-morphological traits between five varieties of vetch used in this study thus, the improvement of this crop is possible through the breeding techniques.

Keywords: Vetch (*Vicia Sativa),* Varieties, Seeding Rates, Fertilizer Application, Growth, Forage Yield, Forage Yield Components, Cluster Analysis

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1. INTRODUCTION

Vetch (*Vicia sativa* L.) known as the common vetch, garden vetch, tare, or simply vetch (Salehi *et al.,* 2021), is a common forage legume in rainfed and semiarid systems of the Mediterranean region (Tuna & Orak, 2007). The common vetch (Family Fabaceae/ Leguminosae/ Papilionoidea) is one of the world's most economically important annual seed legumes (Mikic *et al.,* 2009). Although the species originated from the arid regions of the Middle East (Ford *et al.,* 2008), it is now widely distributed around the world (Dong *et al.,* 2019), and it is the most important legume used for fresh and dry fodder production in Turkey, it has an important role in crop rotation before sowing of wheat (Tuna & Orak, 2007). Also used as a cover crop, green manure, pasture, silage, and hay its high dry matter content and nitrogen accumulation, and the absence of hard seeds, make it an excellent winter leguminous cover crop in annual rotation (Albayrak *et al.,* 2006).

Vetch is suitable for fertile soils (Avci, 2021) because vetch has the ability to form a symbiotic relationship with rhizobia bacteria that take nitrogen from the soil and convert it into ammonia, which is quickly converted into amino acid and proteins, the vetch plant provides the bacteria with a suitable environment in root nodules, nutrient, and energy. in turn, the bacteria provide nitrogen to the plant through this fixation process (Cassida, 2004). Although traditionally have been used in rotation with cereals; this provides enough residual nutrients to maintain soil fertility for vetch growth (Brust, 2019). Common vetch varieties have some resistance to grazing after 15 nodes (30cm high) till the start of flowering. Regrowth is dependent significantly on rain or available moisture after grazing (Rukiya, 2019). It has a strong root system that develops nodules at an early stage; this provides sufficient nitrogen for the plants to use and accumulates significant amounts for the following crops (Rani *et al.,* 2021).

Seeding rates (SR) directly influence plant population, the productivity of tillers, and, consequently, the production of pasture. Oftentimes in farms, SR is increased prior to the entry of the animals into the pasture, thus, reducing autumn forage deficits. Commonly recommended SR of common vetch range from 30 to 40 kg ha^{-1} (Balbinot Junior *et al*., 2011). However, these recommendations are not based on research findings, but practical experience. Most studies on the vetch crop have tested it as a cover crop (Chiamolera *et al*., 2013). Thus, there is a need to increase the research efforts related to determining vetch – and other legumes – optimum SR (Vonz *et al.*, 2021). The efficient use of fertilizers is an important goal in maximizing the yield of a crop in a way that has a minimal impact on the environment. Nitrogen is widely considered one of the major essential nutrients for plant growth (Ali *et al*., 2011)

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Aim of the study

The objective of this study is to determine the influence of seeding rates and nitrogen fertilizer on the growth, forage yield, and its components of five vetches (*Vicia sativa*) varieties under rainfed conditions in sulaimani district.

2. MATERIALS AND METHODS

A field experiment was conducted under the rainfed condition of the Qlyasan location during 2020-2021 growing season. The experiment will consist of 20 treatment combinations comprising five varieties of Vetch obtained from Agricultural Research Centre-Sulaimania (Morrd, Rook, Excel, Clima, and Namoi), two seeding rates (40 Kg/ ha and 60 Kg/ha), and two Nitrogen applications (no fertilization 0Kg N/ha and fertilization 40Kg N/ha) as urea (46.6% N) that were applied by two doses, the first dose was applied at sowing time and the second dose was applied after forage cutting. The phosphorus at the rate (30kg P_2O_5/ha) was applied as triple super phosphate as a basal dose before sowing. The experiment was conducted in a split-split plot layout arrangement with a randomized complete block design (RCBD) with three replications. The main plots were fertilizer applications and subplots were five varieties of vetch, while sub-sub plots were two different seeding rates. All plots of the experiment were cut at 50% flowering stage, and the data was recorded on different traits, growth, forage yield, and its components as follows:

2.1. Growth Traits were Studied:

- No. of Days to 50% flowering: number of days required to 50% flowering was recorded from the sowing date.
- Plant Height (cm)
- No. of Brunches/ Plant
- No. of Leaves/ Plant
- Weight of Leaves/ Plant (gm)
- Weight of Stems/ Plant (gm)
- Root Length (cm)
- Root Weight (gm)

2.2. Forage Yield Traits: Cutting was conducted for each plot at the height (6-8cm) from the soil surface to determine:

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2.2.1. Fresh Forage Yield (ton ha^{-1}): Fresh forage weight (g.m^{-2}) was determined and then converted to (ton. ha^{-1}).

2.2.2. Dry Forage Yield (ton ha^{-1}): Forage dry matter yield was recorded and converted into dry matter production by using the following formula.

Dry yield (Kg/ha) = Dry yield in cut plot/ Plot area * 10000

2.2.3. Dry Matter%: The sub-samples were taken (100g) to put in the oven at 65 C˚ for 72 hours to determine the dry matter percentage.

2.3. Forage Yield Components:

2.3.1. Fresh Leaf %: The sub-sample (100g) was taken from each plot and separated into leaves and stems then leaves weight was determined

2.3.2. Fresh Stem %: The weight of fresh stems for 100g of forage was recorded.

2.3.3. Fresh Leaf/Stem Ratio: The ratio of fresh leaf percent divided by fresh stem percent for each plot.

2.3.4. Dry Leaf %: The weight of dry leaf from 100g of forage was recorded after drying in the oven at 65 C˚ for 72 hours.

2.3.5. Dry Stem %: The weight of dry stems from 100g of forage was recorded after drying in the oven at 65 C˚ for 72 hours.

2.3.6. Dry Leaf/Stem Ratio%: The ratio of dry leaf percent divided by dry stem percent for each plot.

2.4. Statistical Analysis: The recorded data was statistically analyzed by using a statistical program (OPSTAT). The treatment means were compared at a 5% probability level by using the least significant difference (LSD) test (Steel *et al*., 1997).

2.5. Cluster Analysis: Cluster analysis is often used to assess genetic diversity and to classify species (Firincioğlu *et al.,* 2007). The Hierarchical Cluster Analysis based on Euclidean Distance and Unweighted Pair-group Method with Arithmetic Linkage (UPGMA) was performed to classify the vetch varieties relatedness based on agro- morphological traits using IBM SPSS program, Ver. 19 (Livanios & Bebeli, 2018).

3. RESULTS AND DISCUSSIONS

Data in table 1 explain the influence of fertilizer application on growth traits of vetch was significant for all traits except the character weight of stems. plant^{-1} which was found to be not significant. The minimum number of days was 122.600 required to 50% of flowering

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recorded by fertilizer application in comparison to without fertilizer application which required a maximum number of days to50% flowering. Maximum values for plant height and root weight were 43.175cm and 0.642gm respectively obtained without nitrogen fertilizer, while minimum values for both traits were 42.196 cm and 0.576gm respectively recorded when applied nitrogen fertilizer. But the highest values were 8.621, 56.551, 7.769gm, and 13.341cm for no. of brunches.plant^{-1}, no. of leaves.plant^{-1}, the weight of leaves.plant^{-1} and root length respectively recorded when applied nitrogen fertilizer, while the lowest values for these traits were 7.935, 48.648, 7.156gm and 12.908cm respectively obtained without nitrogen application. because nitrogen application increase soil fertility and therefore due to high vegetative growth of the crop, this result is in line with the previous work of (Schwartz and Amasino.2013) found that flowering time influences the final N content in biomass; late-flowering accessions produce more leaves and accumulate more total N, and the main effects of N rates had a significant influence on all growth traits except the weight of stems.plant^{-1}. Also, previous research results showed that the highest level of NPS rate (200 to 250 kg ha^{-1}) resulted in higher values of the number of primary branches per plant. Abayomi, e*t al.* (2008) achieved that plant height and number of leaves per plant at 50% flowering were the highest level of fertilizer applied. Root growth generally parallels shoot growth in crop plants. When a large amount of nutrients, especially N, is supplied to leaves from roots, photosynthesis remains high during maturation, which secures the supply of carbohydrates to roots. Hence, the activities of roots and shoots are mutually dependent (Fageria & Moreira. 2011). Also, previously shown that plant height, and the number of leaves per plant was the highest level when fertilizer was applied (Abayomi *et al*., (2008). The higher plant height with surplus nitrogen is mainly reflected by the increase in inter nodal distance which results in stem elongation {Eltelib *et al.,* (2006), Ayub *et al*., (2007) and Khalid *et al*., (2003)}. On the other hand, previous research confirmed that growth characteristics (plant length, leaf number, number of tillers) were not significantly influenced by nitrogen fertilization levels (Zewdu *et al.,* 2003).

Table 1: Influence of Fertilizer Application on Growth Traits of Common Vetch.

Fertilizer	No. of Days to 50% Flowering	Plant Height (cm)	No. of Brunches. Plant^{-1}	No. of Leaves. Plant^{-1}	Weight of Leaves. Plant^{-1} (gm)	Weight of Stems. Plant^{-1}	Root Length (cm)	Root Weight (gm)
0 Kg N/ha	123.800	43.175	7.935	48.648	7.156	6.792	12.908	0.642
40 Kg N/ha	122.600	42.196	8.621	56.551	7.769	6.690	13.341	0.576
LSD (P≤0.05)	5.729	4.808	1.590	10.167	1.174	N.S	1.594	0.175

Table 2 illustrate that the influence of varieties on growth traits of common vetch was significant for all characters. Varieties 1,3 and5 required a minimum number of days to 50% flowering 112.000, while variety 2 required a maximum number of days 142.333 to

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50% flowering. The highest values for plant height, no. of leaves. plant^{-1}, the weight of stems.plant^{-1} root length and root weight exhibited by V_2 were 50.274cm, 71.940, 8.812,14.387cm, and 1.049gm respectively, also V_3 gave maximum values of no. of brunches.plant^{-1} and weight of leaves.plant^{-1} were 9.008 and 8.936gm respectively, whereas minimum values of plant height, no. of brunches.plant^{-1} no. of leaves.plant^{-1} and weight of stems.plant^{-1} were 34.831cm, 7.053, 39.358, and 4.779 recorded by V_1, while minimum values of the weight of leaves.plant^{-1}, root length, and root weight were 5.707gm, 12.246 cm, and 0.308gm exhibited by V_2 and V_5 respectively. This variability among varieties in growth traits may be positively and strongly related to the differences in the genetic map and this adaptation to the climate, this result was in agreement with the results reported by (Fatih, 2019, and Tawfiq & Muhammed, 2014). In addition to genetic variability, soil fertility and environmental conditions could also contribute to the difference in plant height (Kebede, 2018). In addition, it has been frequently reported that determining the factors that affect flowering time and dormancy in Switchgrass is likely to be difficult, due to the extensive natural variation and genetic complexity within the species {Casler *et al.*, (2004, 2007); Berdahl *et al*., (2005); Casler, (2005)}, but Georgieva *et al.,* (2020) indicated that plant height is a characteristic mostly dependent on genotype rather than on cultivation techniques, such as plant density.

Table 2: Influence of Varieties on Growth Traits of Common Vetch.

Varieties	No. of Days to 50% Flowering	Plant Height (cm)	No. of Brunches. Plant^{-1}	No. of Leaves. Plant^{-1}	Weight of Leaves. Plant^{-1} (gm)	Weight of Stems. Plant^{-1}	Root Length (cm)	Root Weight (gm)
V_1	112.000	34.831	7.053	39.358	8.113	4.779	12.413	0.445
V_2	142.333	50.274	8.803	71.940	5.707	8.812	14.387	1.049
V_3	112.000	40.581	9.008	53.553	8.936	6.793	12.524	0.429
V_4	137.667	46.608	8.669	55.300	6.684	8.285	14.053	0.815
V_5	112.000	41.136	7.858	42.848	7.871	5.035	12.246	0.308
LSD ($P \le 0.05$)	4.089	5.755	1.438	11.529	0.315	2.802	3.032	0.227

gume Inoculation . University of Arkansas, Division of AgrFigure 1: The result of cluster analysis of all common vetch varieties based on growth traits shown in figure 1 confirmed that there were three major (K=3) groups for studied common vetch varieties the first group consist of two varieties V_4 and V_2, the second group consist of one variety was V_3 and the last group was two varieties V_1 and V_5.

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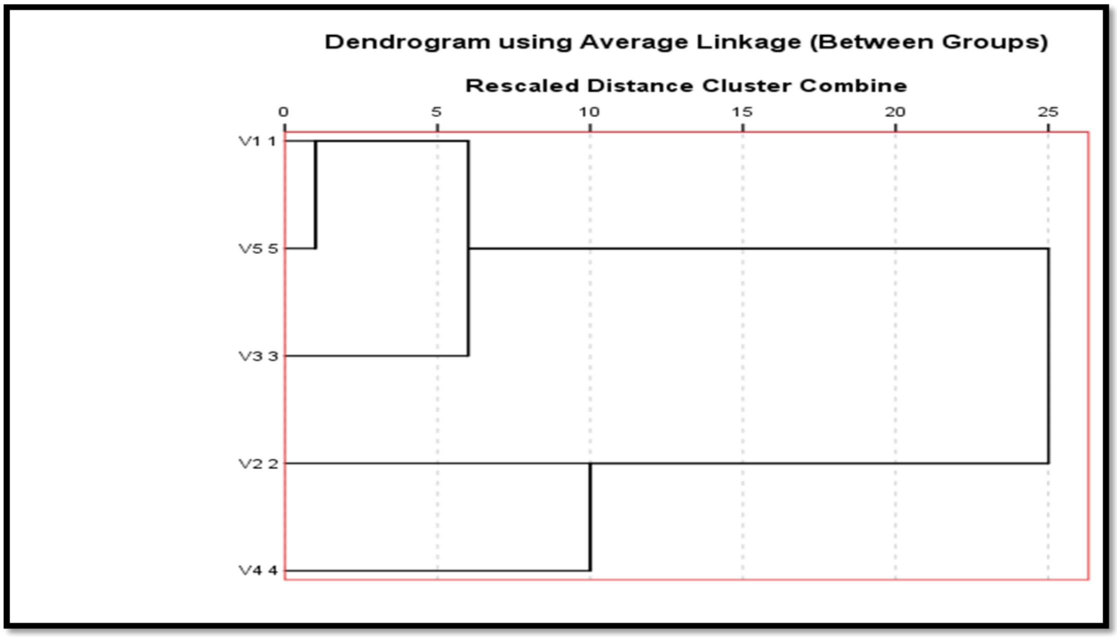
Figure 1: Dendrogram of five common vetch varieties based on cluster analysis of growth traits.



Results of table 3 clarify that the influence of seeding rates on growth traits of common vetch was significant for all traits except the traits no. of branches.plant^{-1}, the weight of stems.plant^{-1}, and root length cm which were not significant. The maximum number of days required for 50% flowering was 123.800 recorded by a seeding rate of 40kg.ha^{-1}, while the minimum number of days was 122.600 exhibited by using 60kg.ha^{-1}. The highest plant height 43.686 cm recorded with 60kg.ha^{-1}, in which the lowest plant height 41.686 cm obtained by using 40kg.ha^{-1}. The seeding rate is 40kg.ha^{-1} gave the maximum number of leaves.plant^{-1} and root weights were 55.547 and 0.643 gm respectively, but minimum values for both traits were 49.652 and 0.575gm recorded by using 60kg.ha^{-1} respectively. Regarding the weight of leaves. Plant^{-1} the highest weight was 7.770gm obtained by 60kg.ha^{-1}, while using the seeding rate of 40kg.ha^{-1} gave the lowest weight of leaves.plant^{-1} which was 7.155gm. The result of the present study showed that by increasing the seeding rate plant height was increased, this was opposite to the result of the previous studies which confirmed that equally high plants were recorded for both seed rates, demonstrating that an increase in seed rate does not always lead to an increase in plant height (Falster *et al*., 2003 and Georgieva *et al*., 2020). The number of primary branches was negatively related to the seeding rate, due to increase competition between plants for growth factors, which finally reduced the

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number of effective branches. Our results support the results of previous studies on the influence of seeding rate on the number of primary branches (Yilmaz & Erayman, 2015).

Table3: Influence of Seeding Rates on Growth Traits of Common Vetch.

Seeding Rates	No. of Days to 50% Flowering	Plant Height (cm)	No. of Brunches.Plant^{-1}	No. of Leaves. Plant^{-1}	Weight of Leaves. Plant^{-1}	Weight of Stems. Plant^{-1}	Root Length (cm)	Root Weight (gm)
40 kg. ha^{-1}	123.800	41.686	8.329	55.547	7.155	6.908	13.131	0.643
60 kg. ha^{-1}	122.600	43.686	8.227	49.652	7.770	6.573	13.118	0.575
LSD (P≤0.05)	2.503	0.618	N.S	4.228	0.793	N.S	N.S	0.099

Table 4 shows that the influence of fertilizer application on forage yield traits of common vetch was significant for green forage yield and dry forage yield, but for dry matter percent was not significant, maximum green forage yield and dry forage yield were 8.346 and 1.495 ton.ha^{-1} exhibited by application of 40 Kg N/ha, while no fertilizer application gave minimum values of both traits were 7.580and 1.349 ton ha^{-1} respectively. Notably, fresh, dry forage yield and dry matter percent increased by applying fertilizer due to enhance vegetative growth and yield, this result is in agreement with the results of Abayomi *et al*., (2008) which was noticed that plant dry matter at 50% flowering were highest when fertilizer applied. Also, Tariq, *et al*., (2011) confirmed that dry matter yield increased significantly ($p<0.05$) as the nitrogen fertilization level increased from 200 kg/ha to 400 kg/ha, but the fresh yield was not significantly different according to nitrogen fertilization level ($p<0.05$). The lower fresh and dry matter yield with reduced nitrogen rates is the result of more dependence on plants for nitrogen in soil resources (Eltelib *et al*., 2006).

Table 4: Influence of Fertilizer Application on Forage Yield Traits of Common Vetch

Fertilizer	Green Forage Yield (Ton. ha^{-1})	Dry Forage Yield (Ton. ha^{-1})	Dry Matter %
0 Kg N/ha	7.580	1.349	17.997
40 Kg N/ha	8.346	1.495	18.153
LSD	1.410	0.233	N.S

Table 5 showed that the differences between varieties due to forage yield traits were significant for all the characters. The highest value of green forage yield was 11.434 recorded by V2 but for dry forage yield and dry matter percent were 1.957 ton.ha^{-1}, 18.552% exhibited by V4 respectively, while the lowest value for green and dry forage yield was 4.073, 0.748 respectively showed by V1 and V2 gave a minimum percent of dry

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matter 17.079%. The differences among varieties performance are due to the differences in the genetic map of each variety.

Table 5: Influence of Varieties on Forage Yield Traits of Common Vetch.

Varieties	Green Forage Yield (Ton. ha^{-1})	Dry Forage Yield (Ton. ha^{-1})	Dry Matter%
V_1	4.073	0.748	18.526
V_2	11.434	1.950	17.079
V_3	6.725	1.208	18.067
V_4	10.620	1.957	18.552
V_5	6.964	1.247	18.151
LSD (P≤0.05)	1.942	0.302	0.690

Table 6 illustrate the influence of seeding rates on forage yield traits of common vetch were significant for all the characters, maximum green forage yield and dry forage yield were 8.814and1.569 ton.ha^{-1} respectively exhibited by 60 kg.ha^{-1} seeding rate, while 40 kg.ha^{-1} seeding rate gave minimum values of their traits were 7.112 and 1.275 ton ha^{-1} respectively. But for dry matter maximum value was 18.239% recorded by S_1 and the minimum value was 17.911% recorded by 60 kg.ha^{-1} seeding rate. The effect of seeding rates was significant for forage yield and dry yield, or by increasing seeding rate plant density increased, and high yields were obtained. This result agrees with the previous results shown by Turk *et al*., (2011). Also, Narbon vetch yields were substantially increased by early sowing (14 Jan.) and high seeding rate (80-plant·m^{-2}) {(Turk & Tawaha, (2002) and Yilmaz & Erayman, (2015)}. Previously many researchers reported that increasing seed rate resulted in an increased dry matter yield of different legume species including common vetch (Atis *et al.,* 2012, Tigka *et al.,* 2021), which is disagree with our study.

Table6: Influence of Seeding Rates on Forage Yield Traits of Common vetch.

Seeding Rates	Green Forage Yield (Ton. ha^{-1})	Dry Forage Yield (Ton. ha^{-1})	Dry Matter %
40 kg. ha^{-1}	7.112	1.275	18.239
60 kg. ha^{-1}	8.814	1.569	17.911
LSD (P≤0.05)	0.668	0.134	0.570

Table 7 showed that the influence of fertilizer application on forage yield components was significant for all characters, the highest percent of the fresh leaf was 68.874, fresh leaf/stem ratio 2.515, dry leaf was 14.199 and dry leaf/stem ratio was 3.820 recorded when applied 40kg nitrogen fertilizer, but the highest percent were 30.229and 4.080 for fresh stem and dry stem respectively obtained without nitrogen fertilizer application. On the other hand, the lowest values of fresh leaf percent 67.760, fresh leaf/stem ratio 2.409, dry leaf

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percent 13.917, and dry Leaf/Stem ratio 3.596 recorded without nitrogen fertilizer application, also the lowest values were 29.116 and 3.953 for fresh and dry stem percent respectively obtained when applied nitrogen fertilizer by 40 Kg N/ha. The role of nitrogen with respect to leaf to stem ratio was significant and is mainly attributed to more leaf mass production per plant. It showed that among the aerial plant parts, the leaves are more responsive to additional nitrogen supply than stems, this result agrees with the result of Tariq *et al*., (2011).

Table7: Influence of Fertilizer Application on Forage Yield Components of Common Vetch.

Fertilizer	Fresh Leaf %	Fresh Stem %	Fresh Leaf/ Stem ratio	Dry Leaf %	Dry stem %	Dry Leaf/ Stem ratio
0 Kg N/ha	67.760	30.229	2.409	13.917	4.080	3.596
40 Kg N/ha	68.874	29.116	2.515	14.199	3.953	3.820
LSD (P≤0.05)	2.162	0.923	0.331	1.397	0.717	1.160

Table 8 confirmed that there were significant differences among varieties due to forage yield components of common vetch. V_1 gave maximum values of fresh leaf %, fresh leaf/stem ratio, dry leaf%, and dry leaf/stem ratio were 77.239, 3.529, 15.558, and 5.442 respectively, but regarding fresh and dry stem percent, the highest values for both traits exhibited by V2 and V4 were 35.514%, 4.923% respectively. V2 gave minimum values of fresh leaf percent 61.208, fresh leaf/stem ratio1.812, dry leaf percent 12.708, and dry leaf/stem ratio 2.729, and minimum values of fresh and dry stem percent were 22.761 and 2.968 recorded by V_1.

Table 8: Influence of Varieties on Forage Yield Attributes of Common Vetch.

Varieties	Fresh Leaf %	Fresh Stem %	Fresh Leaves/ Stem ratio	Dry Leaf %	Dry stem %	Dry Leaves/ Stem ratio
V1	77.239	22.761	3.529	15.558	2.968	5.442
V2	61.208	35.514	1.812	12.708	4.371	2.729
V3	70.422	29.578	2.423	14.103	3.963	3.611
V4	62.528	30.700	2.155	13.628	4.923	2.811
V5	70.190	29.810	2.391	14.293	3.858	3.747
LSD (P≤0.05)	3.732	6.275	0.567	1.084	0.412	0.595

Data represented in table 9 explain that the influence of seeding rates on forage yield components of common vetch was significant for all traits. The highest values of fresh leaf%, fresh leaf/stem ratio, dry leaf%, and dry leaf/stem ratio were produced by using 40kg.ha^{-1} seeding rates were 69.779%, 2.622, 14.323%, and 3.926 respectively, but concerning fresh and dry stem percent the seeding rate 60 kg.ha^{-1} gave maximum percent of both traits were 30.696 and 4.117 respectively, while 40kg.ha-1 seeding rate gave the lowest values for fresh stem 28.649% and dry stem 3.916%. Also, the lowest values for

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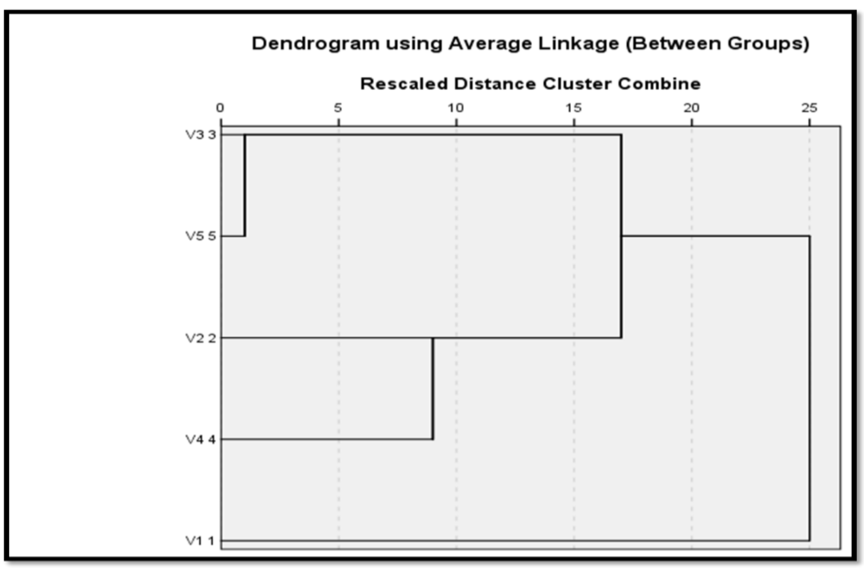
fresh leaf %, fresh leaf/stem ratio, and dry leaf/stem ratio were produced by using 60kg.ha^{-1} seeding rates were 66.856%, 2.303 and 3.490 respectively. In general, there was a significant difference in the forage yield attributes this result agrees with the result of (maleko *et al.,* 2019).

Table 9: Influence of Seeding Rates on Forage Yield Components of Common Vetch.

Seeding Rates	Fresh Leaf %	Fresh Stem %	Fresh Leaf/ Stem ratio	Dry Leaf %	Dry stem %	Dry Leaf/ Stem ratio
40 kg.ha^{-1}	69.779	28.649	2.622	14.323	3.916	3.926
60 kg.ha^{-1}	66.856	30.696	2.303	13.793	4.117	3.490
LSD (P≤0.05)	2.038	2.159	0.249	0.618	0.236	0.314

Based on the data for this investigation, a cluster analysis was performed, according to which the samples are divided into three major clusters from the dendrogram in Figure 2 for studied common vetch varieties based on forage yield and its components, the first cluster consists of one variety was V_1, the second cluster consist of two varieties V_2 and V_4, and the last cluster were two varieties V_3, V_5.

Figure 2: Dendrogram of five common vetch varieties based on cluster analysis of forage yield and its components.



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4. CONCLITIONS:

From the result of this investigation, we concluded that the application of nitrogen fertilizer caused to increase in some growth traits of vetch such as no. of branch. plant^{-1}, no. of leaves. plant^{-1}, weight of leaves. plant^{-1} and root length, green forage yield, dry forage yield, dry matter%, fresh leaf%, fresh leaf/stem ratio, dry leaf%, and dry leaf/stem ratio. Variety 2 (Rook) gave the highest value for most growth traits, green forage yield, and dry forage yield, but the lowest dry matter% was obtained by this variety, and variety 1 (Moord) was the best among other varieties for forage yield components such as fresh leaf%, fresh leaf/stem ratio, dry leaf%, and dry leaf/stem ratio. By increasing the seeding rate plant height, weight of leaves. plant^{-1}, green forage yield, dry forage yield, fresh stem%, and dry stem% were increased but other growth traits and dry matter% decreased. Cluster analysis results indicate the presence of high variability based on agro-morphological traits between five varieties of vetch used in this study thus, the improvement of this crop is possible through the breeding techniques.

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