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Research Article

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Farmer's Knowledge, Perception, & Management of Major Diseases of Ginger in Palpa District, Nepal

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Abstract

Ginger, a high-value spice crop of mid-hill regions in Nepal, is ranked fourth in global ginger production. Palpa is one of the major ginger-producing districts of Nepal. The survey was conducted in the Ginger Block of Agriculture Knowledge Center (AKC), Palpa using a semi-structured questionnaire, key information interview, and focus group discussion on the knowledge and management of ginger disease. Out of 905 respondents, 90 ginger farmers from the Bagnaskali, Nisdhi, and Purbakhola rural municipalities were randomly selected for the study. Both primary and secondary data were collected and analyzed through computer software like the Statistical Package for Social Science (SPSS) and Microsoft- Excel including simple descriptive statistics, chi-square test, and independent t-test. Rhizome rot (Index -value 0.95), was reported as a major disease followed by Bacterial wilt, leaf spot, soft rot, and storage mold and disease severity occurs 3-5 months day after sowing (DAS). Most farmers adopted the cultural method instead of the chemical method despite a high literacy rate and had a significant association with the use of chemical pesticides at a 5% level of significance. Furthermore, training had found a significant association with farmers' knowledge level of diseases at a 1% level of significance. Farmers had perceived a 31.58 % yield loss due to disease, 40% loss of income, and agriculture income had found a positive influence on the adoption of disease management. Thus, effective and efficient disease management methods should be adopted to hinder yield loss and control disease.

Keywords : Agriculture, Production, Rhizome rot, Severity, Yield,

Introduction:

Ginger (*Zingiber officinale var. Roscoe)* is a subtropical, perennial, herbaceous plant that belongs to the family Zingiberaceae and it is generally grown in tropical and subtropical parts of the world (Joshi, 2021) (Zakka, 2010). Furthermore, India ranks first position and Nepal holds the fourth position, contributing 11.5% of total ginger production worldwide (Mahat, 2019). Ginger is one of the high-value spicy crops which is grown in mid-hill regions of Nepal. Ginger, one of the commercial spice crops, is used for powder, oil, and oleoresin which have food and medicinal value (Kumar, 2018). In the context of Nepal, the total area under cultivation is 23,500 ha with a production of 2,98,945 mt/ton (MOALD, 2019/2020). Moreover, Salyan, Ilam, Nawalparasi, and Palpa are the major ginger-producing districts of Nepal in terms of national ginger production (Singh, 2013). Likewise, has a cultivation area of 862ha, production of 10516 mt/ton,

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and productivity of 12.19 tons/ha (Poudel R. R., 2015) (MOALD, 2019/2020). In addition, it shares 3.51 % of the total national ginger production and 3.66 % of the total cultivated land area (MOALD, 2019/2020).

Despite being renowned for having huge potential for ginger production the district is with below the potential yield of 24.5 tons/ha, and also national productivity of ginger (12.72ton/ha) (Khatiwada, 2022) (MOALD, 2019/2020). The gap between the average productivity of the district and the national productivity of ginger might be due to the result of biotic factors and abiotic factors (Gautam J. &., 2020). The area under ginger cultivation of Palpa in the fiscal year 2017/18 was 1282 ha which decreased to 862 ha in the fiscal year 2019/2020 (MOALD, 2019/2020). Moreover, ginger is one of the cash-generating spicy crops of Nepal, and the majority of farmers were not satisfied and demotivated to ginger farming due to the prevalence of disease and insect pests, lack of seed quality, low price during marketing, and lack of proper irrigation facilities (Neupane, 2019). In Nepal, six diseases and five insect pests of ginger are economically important (Gautam J. &., 2014). The diseases, one of the major constraints of ginger production, reduce up to 50 % of rhizome production. as rhizome rot alone causes 25 % yield loss in the field and 24 % in storage conditions (Acharya B. &., 2015). Rhizome rot (*Pythium spp.)*, dry rot (*Fusarium oxysporum f.sp. zingiber)*, Bacterial wilt (*Ralstonia solanacearum,)*, leaf spot (*Phyllosticta zingiber Ramkr)*, and storage mold (A*spergillus flavus)* are common diseases of ginger in the context of Nepal (Khalequzzaman, 2021).

Moreover, Farmers' knowledge level of disease management is also low and they have the wrong perception of disease management as the majority of the farmers in the study area were illiterate. The majority of the farmers are less concerned about disease management and the adoption of the economic and effective approach to control management practices. Thus, the objective of the study sought to identify constraints of ginger production, identify major diseases, assess the knowledge level of farmers, assess yield loss due to disease, and ascertain the management method based on farmers' perceptions. This study will help farmers to choose best management practices for disease, and provide information about the yield of ginger thereby providing information on disease severity and yield loss.

Materials and Method:

Survey site and sample size

The survey was conducted between 1st week of March – the 3rd week of April 2022 in a ginger block of Agriculture Knowledge Center, Palpa. Out of a total of 905 ginger farmers who were registered in the Agriculture Knowledge Center, Palpa Agriculture Knowledge Center (AKC) is a government body for research and extension in the agriculture sector under the Provincial Ministry of Land Management, Agriculture, and Co-operatives. 90 respondents were selected through a simple random sampling method by using Yamane's Formula (n=N/ (1+Ne 2) where, n =sample size, N= population size, e= Margin of error) at a 90% level of confidence and a 10% margin of error. The survey was conducted with a pre-tested questionnaire in Bagnaskali, Nisdhi, and Purbakhola rural municipalities respectively as they were the command area of AKC, Palpa.

Sources of Information

For the study, primary data were collected from a preliminary survey, pre-tested questionnaire, key information interview, focus group discussion, and semi-structured questionnaire and Secondary data were from the annual report of AKC, DADO (Palpa), article, booklets, Ministry of agriculture and livestock development (MoALD), Department of Agriculture (DAO) and Central bureau of statistics (CBS), etc.

Data analysis

The data were analyzed through computer software tools like the Statistical Package for Social Science (SPSS, version 26) and MS Excel. Simple descriptive statistics, chi-square test, and Independent t-test were used to compute socioeconomic characteristics, and the association between two variables, to ascertain the relation between two variables.

Scaling of cultivation problem and management practices

The forced ranking method was used to identify farmer's perception towards problems and major diseases with a five-point scaling technique comprising most severe, severe, moderate, mild, and most mild having scale values 1, 0.8, 0.6, 0.4, and 0.2 respectively, by using the following formula (Soni, 2019).

$I = \sum(Sifi/N)$

Where, I = Index value ($0 < I > 1$)

Si = Scale value

fi = Frequency of respondents

N= Total number of respondents

Scoring of the knowledge level of farmers

Farmers' knowledge level of disease and the questions were evaluated by following the knowledge score level (Midega, 2016) (Table 1).

Table 1: Scale (Midega, 2016) for scoring the knowledge level of farmers on diseases and insect pests of ginger

Score	Knowledge level	Criteria
0	No	Farmers were unable to describe a disease by name, its symptoms, or the type of damage it caused
1	Low	Farmers were able to name one disease, one feature, and one type of damage caused by them.
2	Medium	Farmers were able to name two diseases, describe at least one characteristic of each disease, and the type of damage caused by each of the two diseases.
3	High	Farmers named two or more diseases and described at least one of the features of each disease and one type of damage caused by each of the three diseases or pests.

Results:

Socio-demographic characteristics

The average productivity of the area was found to be 4.55 q/ropani (9.1 Mt/ha) which is lower than the national productivity of ginger (12.72ton/ha) which might be due to rhizome rot infestation, and years of ginger farming experience was found as 15.36 in the study area (MOALD, 2019/2020). Furthermore, 81.1 % of respondents had a male member, and 18.9 % of respondents had a female member as head of a household which implies that male-headed families were prevalent in Palpa district, mid-hills region of Nepal, consistent with the result found in Surkhet, Nepal (Mahat, 2019). The study shows that 64.4% (58) respondents belonged to the 39 – 60 age group, 21.1 % (19) to above 60 age group, and 14.4 % (13) respondents below 39 age group which affirmed that ginger farming was dominated by working-age people (active age group, 39-60) who can adopt new technology, disease management method leading to the increasing production and make a ginger enterprise profitable. It is evident that 22.2 % (20) respondents were illiterate which inferred that 78.8 % were literate: 24.4 % (22) had a primary level, 31.1 % (28) had a secondary level, indicating that a higher level of education with the result of than others which play a significant role as education had a direct association with production, productivity, adoption of technology and management of disease,12.2 % (11) had high school level of education and 10.0 (9) respondent had university level of education respectively (Ejechi, 2018) (Poudel R. R., 2017). Moreover, the majority of respondents that is 56.9 % (53) were Brahmin/Chhetri followed by Janjati 29.8% (25), and Dalit 13.3 % (12) respectively. Moreover, the study reports that 100 % (90) followed the Hindu religion, 55.6 % (50) had a nuclear type of family whereas 44.4 % (40) respondents had a joint type of family. The study revealed that 27.8 % (25) respondents had at least one member abroad whereas 72.2 % (65) had not any member abroad in the study area. According to the survey, the majority of the respondents i.e. 58.9 % (53) had a major occupation as agriculture which is one of the major sources of income in the district followed by remittance 17.8% (16), service 14.4% (13), business 7.8% (7), and others 1.1 respectively (https://censusnepal.cbs.gov.np/Home/Index/EN) (Table 2).

Distribution of respondents by family characteristics and income in the study area

The study revealed that the average family size of the respondents was found as 5.80 in the study area which is more than the average family size (4.32) in Nepal as the study was carried out in a rural part of Nepal, where population density was high. In addition, the Average male member and average female member were 3.12 and 2.68 respectively which implies that the male member was greater than the female member in the family. Moreover, the average economically active member and average non-economically active member were 3.97 and 1.83 inferred that non-economically active members were dependent on an economically active member in a family. The average income of respondents was found as NRs. 307500.00; out of which, income from agriculture was NRs. 146055.56 and income from other sources was NRs. 161444.44 in the study area (Table 3).

Ginger cultivation details

The study reports that the average area of ginger cultivation was only 2.70 (0.137 ha), which inferred that farmers of the study area were not as motivated towards ginger cultivation as the cultivation of other high-value crops which is almost consistent (Khatiwada, 2022). Likewise, the average production of ginger in the study area was 12.30 quintals. The study reports that 56.7% (51) were female and 43.3% (39) were male inferred that ginger farming was dominated by females, which is lined with the result because male members were found involved in outside work rather than farming (Adhikari, 2022). (Table 4).

Table 2: Socio-demographic characters of the farmers in the study area

Description	Frequency	Percent
Gende		
Male	**39**	**43.3**
Female	51	56.7
Head of Household		
Male	**73**	**81.1**
Female	17	18.9
Age of the respondent		
Less than 39	13	14.4
39 -59	58	64.4
More than 60	19	21.1
Education		
Illiterate	20	22.2
Primary level	22	24.4
Secondary level (6-10)	28	31.1
High school (+2)	11	12.2
University level	9	10.0
Ethnicity		
Brahmin/Chhetri	53	56.9
Janjati	25	29.8
Dalit	12	13.3
Religion		
Hindu	100	100
Family type		
Nuclear	50	55.6
Joint	40	44.4
Member abroad		
Yes	25	27.8
No	65	72.2
Major occupation		
Agriculture	53	58.9
Service	13	14.4
Business	7	7.8
Remittance	16	17.8
Others	1	1.1

Constraints of Ginger production in the study area

As mentioned in Table 6, among different constraints reported by the farmer during the pre-testing of the questionnaire, the majority of the respondents ranked the incidence of disease and pests as the major problem with an index value of 0.92 followed by the unfair market price of an index value of 0.73 which aligns with the findings that rhizome rot is the major disease that poses a major threat to ginger production in Nepal (Neupane, 2019).

Diseases of ginger

Problems and identification of diseases of ginger

The results (Table 7) show that 87.8 % (79) respondents had disease problems and 12.2 % (11) respondents hadn't disease problems in the field condition as the

Table 3: Distribution of respondents by family characteristics and income in the study area

Descriptions	N	Minimum	Maximum	Mean	Std. Deviation
Family size of resp.	90	3	10	5.80	1.891
A male member of the Family	90	1	7	3.12	1.207
A female member of the Family	90	1	6	2.68	1.150
Economically active population (15-59)	90	1	8	3.97	1.457
Non-economically active population (below 15 and above 60)	90	0	5	1.83	1.238
Annual income (NRs.)	90	40000	1500000	307500.00	275347.83
Income from agriculture (NRs.)	90	30000	800000	146055.56	115180.59
Income from other sources (NRs.)	90	0	900000	161444.44	227396.40

Table 4: Ginger cultivation area, production, productivity, and year of ginger farming experience in the study area

Description	N	Minimum	Maximum	Mean	Std. Deviation
Area of Ginger cultivation (ropani)	90	.50	14.00	2.7000	2.61242
Production (quintal)	90	2	48	12.30	11.25242
Productivity (quintal/ropani)	90	3	8	4.55	0.75194
Year of ginger farming experience	90	2	40	15.36	12.183

Table 6: Major constraints of ginger production in the study area

Problem	Index value	Rank
Disease and pest	0.92	I
Unfair market price	0.73	II
Lack of technical knowledge & guidance	0.56	III
Lack of quality seed material	0.52	IV
Lack of irrigation, labor, and other inputs	0.25	V

Table 7: Problems and identification of disease of ginger in the study area (2022)

Disease problem	Frequency	Percentage
Yes	79	87.8
No	11	12.2
Total	90	100.0
Yes	63	79.74
No	16	20.26
Total	79	100

majority of the households in the district were affected by rhizome rot disease (Nepali, 2000). Moreover, out of the 79 respondents who had disease problems, 79.74 % (16) respondents could identify disease by observing symptoms and damage of diseases as the majority of the farmers were literate in the study area.

Ranking of major diseases in the study area

The major problems of disease were ranked by using an index of importance (Forced ranking method) based on farmers' perception of disease severity and infestation in their field. The result indicated that major diseases of ginger: Rhizome rot, Bacterial wilt, leaf spot, soft rot, and storage mold were ranked as I, II, III, IV, and V with index values 0.95,0.64,0.62,0.57,0.2 respectively (Table 8) based on disease severity and infestation of the disease study area. Rhizome rot was found as one of the major diseases of ginger which is consistent with the result (Upadhyaya[1], 2020).

Farmer's perception of the stage of disease severity

The Farmers have been used to sow rhizome seeds from March to the last week of May in the Palpa district (Poudel R. R., 2017). The study showed 67.1 % (53) of respondents perceived that disease severity occurs at 3-5

Table 8: Ranking of major diseases in study area (2022)

Diseases	Index value	Rank
Rhizome rot	0.95	I
Bacterial wilt	0.64	II
Leaf spot	0.62	III
Soft rot	0.57	IV
Storage mold	0.2	V

Table 9: Farmer's perception of the crop stage with disease severity percent

Crop Stage	Frequency	Percentage
Seedling stage	1	1.26
3-5 months day after sowing	53	67.1
6-8 Months days after sowing	16	20.25
Harvesting stage	2	2.53
Post-harvest stage	7	8.86
Total	79	100

months DAS (Day After Sowing), followed by 20.25 % (16) respondents at 6-8 months DAS, 8.86 % (7) respondents at post-harvest stage, 2.53 % (2) respondents at harvesting stage and 1.26 % (1) respondents at seedling stage respectively in the study area (Table 9).

Farmer's perception of the severity of disease in the study area

Although disease severity was severe in the field condition, the majority of respondents i.e. 46.84 % (37) had perceived less severity of disease because the majority of the respondents rarely visited their field after sowing the rhizome, followed by 31.64 % (25) as moderately severe, by Severe 15.2 % (12), highly severe 5.06 % (4) and no severity 1.26 (1) in study area respectively (Table 10).

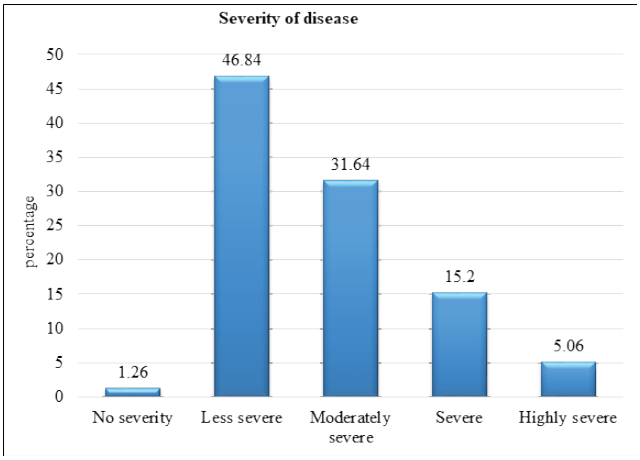

Figure 1: Farmer's perception of the severity of disease in the study area (2022)

Adoption of management of diseases of ginger in the study area

As presented in Table 11, showed that the majority of the respondents91.13 % (72) were adopters of disease management because they unknowingly adopted at least one of the traditional practices of disease management, and 8.87 % (7) respondents were non-adopters of disease management.

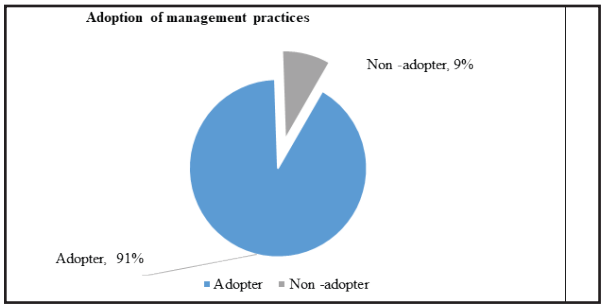

Figure 2: Adoption of management of diseases of ginger in the study area

Management of diseases in the study area

Management practices adopted by farmers in the study area

The study inferred that the majority of the respondents adopted cultural method (Table 12): 91.7 % (66) in which farmers practiced crop rotation with the solanaceous crop, intercropping with maize, drainage for rhizome rot and other diseases, consistent with the results of (Shukla, 2015). Moreover, 88.9 % (64) respondents adopted the physical (hand picking), Mechanical method: 51.4 % (37), Chemical method: 43.1 % (31), and biological method: 40.3 % (29) and 59.7 % (41) respectively, in their field.

Table 10: Management practices adopted by farmers in the study area

Method	Yes	No
Physical	64(88.9)	8(11.1)
Cultural	66(91.7)	6(8.3)
Chemical	31(43.1)	41(56.9)
Biological	29(40.3)	43(59.7)
Mechanical	37(51.4)	35(48.6)
Total (N)	**72(100)**	**72(100)**

Association between education level and use of chemical pesticides

Chi-square (Cal) was found to be 4.25 ** (Tab) =3.84 df at 0.05 level of probability which is highly significant. The calculated value of chi-square (4.25) was statistically significant at a 5% level of significance. Thus, the result indicated that education level had a significant association with the use of chemical pesticides in the study area.

Table 11: Distribution of respondents by their education level and adoption of chemical pesticides in the study area

		Chemical method		Total
		Adopter	Non-adopter	
Education	Illiterate	11	6	17
	Literate	20**	35	55
Total		31	41	72

(Fig in parenthesis shows that ** shows highly significant at a 5% level of confidence)

Farmers' knowledge level of disease in the study area

The study shows that the majority of the respondents i.e. 37.8 % (34) had a medium level of knowledge on disease followed by a low level of knowledge i.e. 34.4 % (31), high level of knowledge i.e. 23.3 % (21) and No knowledge level i.e. 4.4 % (4) in study area respectively (Table 14).

Table 12: Farmer's knowledge level of disease in the study area

Knowledge level	Score	Frequency	Percentage
No knowledge	0	4	4.4
Low	1	31	34.4
Medium	2	34	37.8
High	3	21	23.3
Total		90	100

Association between trained respondents (farmers) and farmers' knowledge level of disease

Farmer's knowledge level of farmers was categorized into two categories based on different training related to disease attended, disease identification, and management strategies i.e. low level and High level. Farmers with no knowledge and low knowledge were kept in low-level categories whereas farmers with medium and extensive knowledge were kept in high-level categories respectively. Chi-square (Cal) was found to be 12.468*** (Tab)=6.635 at df 1, P value (0.000) at 0.01 level of probability which is significant. The calculated value of chi-square (12.468***) was statistically significant at a 1% level of significance. Thus, the result indicated that participation in training had a significant association with farmers' knowledge level of diseases in the study area.

Table 13: Distribution of respondents who participated in training and knowledge level of disease in the study area

Training	Farmer's Knowledge level of disease and pest		Total
	Low level	High level	
Yes	6(17.1)	30(54.5) ***	36
No	29(82.9)	25(44.5)	54
Total	35(100)	55 (100)	90

(Fig in parenthesis shows that *** shows highly significant at a 1% level of confidence)

Farmer's perception of yield loss due to diseases in the study area

The study affirmed that farmers' perception of the area infected due to diseases was found approximately 31.58 which is an incline with the result who reported that 31.12 % yield loss due to diseases (rhizome rot in association with rhizome fly insect) in Nawalparasi, Nepal (Gautam J. &., 2014). Moreover, the approximate percentage of yield decline is 34.89 and the approximate percentage loss of income is 40.50 in the study area. Likewise, the production of ginger in the year of less and high infestation was found to be 4.34 quintal/ropani and 1.71 quintal/ropani in the study area respectively (Table 16).

Discussion:

The mean family size of the survey area was 5.80, more than Nepal's average family size (4.32) (Statistics, 2022). The average productivity of the area was found to be 3.72q/ropani (7.31mt/ha) which is lower than the average yield of Palpa i.e.12.19 mt/ha (Baral, 2021). The incidence of disease was found major problem for ginger farmers in the Palpa district which is supported by the findings regarding diseases of ginger in the Sunsari district (Chalise, 2019). Rhizome rot was found a severe disease in the study area which aligns with the result obtained by the findings of (Neupane, 2019). The majority of Farmers perceived that disease incidence occurs after 3-5 Months of DAS which is also supported by the result of a survey posed by (Gautam J. &., 2014). The approximate area infected by major diseases was

Table 14: Approximate area infected, production, and yield loss due to disease in the study area

Description	N	Minimum	Maximum	Mean	Std. Deviation
Area infected (%)	90	2.00	80.00	31.58	19.52866
Yield decline (%)	90	5	80	34.89	20.417
Loss of income (%)	90	5	90	40.50	22.956
Production in less infestation year (quintal/ ropani)	90	1.00	8	4.34	1.3
Production in the year of high infestation (quintal/ ropani)	90	.50	4	1.71	0.73

found to be 31.58%, supported by a maximum field disease incidence of 31.2 % in Salyan, Nepal (Acharya B. &., 2018). The approximate yield loss of ginger due to disease in the study area was found to be 34.89 percent which is supported by the findings of (Madan, 2016).

Conclusion:

From the survey, it is concluded that the incidence of disease was warranted as a major constraint of ginger production & rhizome rot was found prevalent disease that alleviated ginger production. Farmers' knowledge level of disease was found medium which implied that many of the farmers had attended different related trainings and workshops Although farmers knew about the disease, and had a high literacy rate, they hadn't practiced the economic method of disease management and the majority of the farmers adopted the cultural method instead of the chemical method. Among different determinants of factors affecting management practice, income from agriculture and gender had found a positive correlation on the adoption of disease management because farmers had less income from agriculture so the investment in disease management was low resulting in increasing disease incidence which ultimately hinders ginger production. Moreover, ginger farming was dominated by females & income from agriculture and gender were found major determinants for the management of disease in the district. Therefore, farmers were suggested to emphasize disease management by adopting economic, effective, and integrated disease management approaches to control disease thereby increasing production by hindering loss and damage.

Declaration of conflict of interest and ethical Approval:

The authors declare no conflicts of interest regarding the publication of the manuscript.

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