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DIETARY FIBRE LIGNIN, A RESOURCE ALLOCATION WITH RELATION TO LEAF PLASTOCHRON INDEX IN AGROECOLOGICAL STUDIES OF *ALLIUM HOOKERI* THW. ENUM DURING ZAID CROP SEASON

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Abstract: Because of advancement in scientific research, dietary fibre lignin, a secondary metabolite yielded by metabolic pathway in plant cell enact to resource allocation, disbursement and its administering in *Allium hookeri*, a perennial green leafy herbal spice was explored. In growing green herbal the potential and perspective of resource allocation tactfully evaluated with relation to relative growth rate (RGR) and leaf plastochron index (LPI) connecting to phytology, growth and development of agriculturally important parameters and current model on hi-tech production practices for selective cropping scheme of zaid season for two cropping years. Concerning to structural development of the plant the lignin formation begins when RGR analogously decreases to maturation of growth with coincidence to growth in height and size approaching to zero RGR. Pertaining to correlation of the LPI to lignin indicating the beginning of lignification where LPI value takes part in equal or greater than 0.18 for 0.226 $mg.g^{-1}$ lignin; greater or equal to 1.43 for 0.249 $mg.g.^{-1}$ lignin; equal or greater 2.43 for 0.258 $mg.g.^{-1}$ lignin in 2017 cropping year and LPI greater or equal to 0.27 for 0.234 $mg.g.^{-1}$ lignin; equal or greater in 1.55 for 0.250 $mg.g.^{-1}$ lignin; equal or greater 2.55 for 0.260 $mg.g.^{-1}$ lignin in 2018 cropping year. Exclusive convergent to biochemical functionaries and processes the resource allocation of lignin coincidence with LPI value greater or equal to 0.18 of plant growth and development in *Allium hookeri*. Entirely the established equation of RGR and lignin implicate the absence of lignification correspond to RGR 0.262 day^{-3} i.e. 0.087 day^{-1} and 0.255 day^{-3} i.e. 0.085 day^{-1} in 2017 and 2018 cropping years respectively. The present work out authenticate each additional $mg.g^{-1}$ of lignin in leaves RGR decreases by 0.994 and 0.965 in the 2017 and 2018 respectively. The exploration inferences the lignification is inversely proportional to relative growth rate of the test herbal crop *Allium hookeri*.

***Key words*:** Dietary fibre, Lignin, *Allium hookeri*, Perennial, Leaf Plastochron Index, Relative growth rate, Zaid.

I. INTRODUCTION

It is well known fact that resource allocation a paramount to growth, development, yield formation and defences to abiotic and biotic stresses consequentially compelled to growth and development of growing plants. In growing plants resources of both organic i.e. organic carbon e.g. sugars and inorganic resources i.e. mineral ions and water etc. included in respective forms, organic C that initially produced that in photosynthetic leaves (source) as sucrose administered to the plant body through phloem to non photosynthetic tissues (sinks) for various diverse uses. Basic and essential mineral ions and water which are taken up by roots from soil, water and conveyance to the aerial parts through xylem (Christrine and Nathalic Callier, 1996; Ruan et.al., 2013; Bihmidine et.al., 2013).

Normally, in plants sugars allocate from "source" to "sink". Effectively the greenery parts of plant generate sugars and consequently become centre of source and deliver to different growing parts of the plant via the phloem through translocation, the movement of sugar and other substances like amino acids etc. Thus, the source sugar deliver to different parts of plant body through resource allocation and distribute to roots, young shoots and developing seeds i.e. the point of centre of sink (Chlon and Bush, 1998).

In addition, a dietary fibre, Lignin, the essential secondary metabolite generated by the phenylalanine, tyrosine metabolic pathway in plant cells contribute the second most profuse biopolymers that accounts for 30% of the organic carbon content in biosphere. Further, Lignin, being a complex phenolic polymer, strengthen and intensify plant cell wall rigidity, hydrophobic properties and promotes mineral transport through the vascular bundles in plants (Schielz et.al., 2014; Barros, 2015). Furthermore lignin and its associated metabolisms takes part an important roles not only in the growth and development of plants but also to protects against pests and pathogens (Ithar et.al., 2007) and lodging resistance and in response to various environmental stresses (Shadle et.al., 2007; Mourn et.al., 2010, Peng et.al., 2014) and in human health effect (Lattimer and Haub, 2010; Liu 2003), and in certain cases lignin has biological activity such as anti-tumour and effective to colon cancer etc. (Azadfar et.al. 2015; Vinardell, 2017; Young et.al. 2005). Over and above, lignin being a component of plant cell wall it signifies the enhancement to plant growth and environmental adaptability and use to a resource for field of energy or pharmaceutical industry.

The plastochron index (PI) admits the changes in phases of plant development and metabolism due age and its inevitably used to demonstrate the rate of net photosynthesis, dark respiration, enzyme production, C_{14} distribution (Dickmann, 1971; Dickson, 1986). Moreover, plastochron index (PI) also simplifies the use of morphological indices to semi deterrent nature species (Hanson et.al., 1986). Basically in plant PI and LPI (Leaf plastochron index) values effectively elucidate the expected leaf age (leaf lifespan) and the evolutionary trait of leaf economic spectrum, the scientific variation in leaf appearance rate and other factors other than crop season (Christine et.al., 1996, Naorem et.al., 2018a; 2018b; 2018c; 2018d). Plastochron index and associative indices in *Allium hookeri* had experimentally work out in different targeted objectives [Naorem et.al., 2018(a); (b); (c); (d)]. However the conclusive work on resource allocation and resource distribution was not yet undertaken in depth except a few viz. Seram et.al. (2022a, 2022b), hence the advancement in resource allocation administering of resources energy was felt need to make a speed up frame. Consequently the present work has been undertaken with specific objectives: to computate the plastochron index (PI), leaf plastochron index (LPI), with respect to phenological changes in *Allium hookeri* cv. local type, connecting with the dynamics of leaf appearness, leaf length, relative growth rate (RGR) and lignin formation and their credible practicability of agroecological farming practices and thereof its impact on yield and yield parameters during zaid season of a cropping year.

II. **MATERIALS AND METHODS**

The continuous investigation work was conducted on farmer's experimental field at Moirangkampu Sajeb Loukol in Imphal East district, Manipur (Latitude $23^0$56'N to $25^0$44'N and $93^0$02' E to $94^0$47'E altitude 790m above the M.S.). The essential meteorological data were gathered from Imphal International Airport, Imphal and ICAR, Lamphelpat, Imphal, the nearest meteorological stations from the present experimental field. For the experimentation, *Allium hookeri*, local variety, was planted as early as the status of growing plant attend its observation state prior starting of observation i.e. at 1st week of June 2016. Experimental plots were 1.25×1.25m and planting rate extends 25×25cm for plant to plant and row to row and presented in a randomized block design.

For experimental estimation, twenty (20) plants were randomly marked within each sub plot to accord the leaf number and length. Daily measurement was taken althroughout the investigation period covering from extremely young to fully matured lamina. The plastochron index and other requirements were estimated as per formulae.

In plant the energy (or strictly power) available to the seedling solely depends on leaf area. Ultimately frame the concrete formula following Sibly and Vincent (1997). The mass of the part of the leaf that is involved in photosynthesis is stringently made up to a leaf area.

Thus it comes

Energy available = A×m ---------------------------------- (1)

where 'A' is a constant of proportionality, 'm' is the leafmass. Neglecting for the moment, the cost of maintenance, the energy available is allocated either to leaf growth or to lignification in growth and development of the test plant or herbal. A fraction 'u' of energy is allocated to leaf growth, and the remainder, 1-u' to lignification. Thus mathematically leaf growth is measured by dm/dt and depends both on the allocable energy and on the fraction allocated to leaf growth. Threfore,

$dm/dt=u.Am$ --(2)

which gives the exponential growth leaf mass

$m=m_0e^{uAm}$ --(3)

where m_0 is the leaf mass at time 0. And if m_2 represents the mass of lignin, then allocable energy, "Am" is transfer to leaf growth dm/dt and lignification.

$m_T=m+m_2$ ---(4)

and $dm_2/dt=(1-u)Am\eta_2$--(5)

where η_2 represents the conversion efficiency with which energy is converted to lignin mass. Equation (5) shows that lignin mass grows exponentially, since inserting Eq (3) into Eq (5) we have

$dm_2/dt = (1-\mu)\ A\ \eta_2 m_0e^{uAt}$ -------------------------------------(6)

which can be integrated to give

$m_2 = [\{\eta_2(1-u)\}/u\}\ m_0e^{uAt}$ --------------------------------------(7)

Hence, combining Equations (3), (4) and (7) we get

$m_T = m_0e^{uAt}[\{u=\eta_2(1-u)\ \}/u$ --(8)

Equation (8) shows that total plant mass m_T, grows exponentially Relative growth rate (RGR), measured as $1/m_T$, dm_T/dt is given by

$RGR =1/m_T\ dm_T/dt =uA$ --------------------------------------(9)

Thus, RGR is proportional to the fraction 'u' of resources that are allocated to leaf growth.

Then, Equations (2) (6) (7) and (9) synthesized and it comes

$RGR = 1/m_T.dm_T/dt = 1/m\ \ dm/dt=1/m_2.dm_2/dt$ ---------(10)

Thus, Equation (10) shows that the relative growth rates of m_1, m_2 and m_T are all equal; that is the relative growth rates of the plant components are identical and are alike to the relative growth rate of the whole plant.

Equation (9) can thus be rewrite (for the purpose) in terms of the fraction of energy allocated to lignification which it can now write as u_2, so that

$u_2 = 1-u$ --(11)

and $RGR = A-Au_2$ --- (12)

Thus RGR is negatively proportional to the fraction u_2 of resources allocated to lignification.

Therefore, the regression equation fitted to the plotted against a crude index of lignification x assessed on growth i.e. relative growth rate (RGR) is given as follows-.

$RGR = A-Bx$ -- (13)

where, "x" is the lignifications value. Thus, energy cost (strictly power cost) is measured in units of lost RGR. In other words, energy cost is measured in terms of growth rate that would have resulted if the energy has been allocated to growth.

Determination of Plastochron Index (PI)

The PI was estimated following formula of Erickson and Michelini (1957)

$PI=n+(\ln L_n-\ln R)/\ln L_n-\ln L_{n-1}$ --------------------------------(14)

where

L_{n+1} was the length (mm) of a leaf or organ just shorter than R mm

n was the serial number of leaf/ organ for which is being calculated.

L_n was the length of the next leaf that was slightly longer than 'R'mm

R was the reference length of organ or leaf (30mm)

The Leaf Plastochron Index (LPI) was determined by using the approved formula

LPI=PI-a ---(15)

where, “a” was the serial number of the choosen leaf, PI was the plastochron index

Determination of Relative Growth Rate (RGR)

$$\text{Relative Growth Rate (RGR)} = \frac{\text{Growth in given time period}}{\text{Measurement at start of time period}} \times 100$$

$\therefore$ RGR= $\{(H_2-H_1)/H_1\}\times 100$ ---(16)

where, H_1- height at time zero or 1st time

H_2 – height at recording time or 2nd time

RGR – relative growth rate

Qualitative estimation of Lignin

Following Holloway et.al. (1977) method lignin was quantitatively determined by preparing acid detergent fibre solution by measuring one gram of the dried and ground sample (Ground to pass through a fine approx. 355 micron mesh sieve) in a 500 ml round flask and adding 100 ml of detergent solution and 2 ml of Dekalin. With maximum care the mixtures is heated to boiling in 5 or 10 minutes and adjust to an even level and reflux for 60 minutes. Then through a known weight sintered the mixture was filtered and washed on glass crucible, washed with 200 ml of hot water then with minimum acetone. Dried for eight hours at 105^0C. After proper cooling in a desiccator then reweighed and accord. With acid detergent solution (made by adding 20 g Acetyl trimethylammonium bromide (citrimide) 1L in sulphuric acid, Dekalin (decahydronaphthaline), sulphuric acid (72%), specific gravity 1.634. Add 655.9 ml of concentrated sulphuric acid to 4270 ml of distilled water) the acid detergent fibre was determined then the crucible containing the acid detergent fibre was placed to a 50ml beaker. Further with 72% H_2SO_4 the crucible was covered and stir with a glass rod so as to break up all the lumps. About half way filled crucible with acid and stir. Again refill the crucible with 72% H_2SO_4 and stir at hourly intervals so as acid drain away. Then filter off after three hour as much acid as possible with vaccum and wash content with hot water until free from acid. With care rinse and remove stirring rod. For eight hours or overnight at 105^0C dried crucible. Lastly in a desiccators cooled the materials and weigh. Then ignite crucible for lignin at 55^0C for two hours then cool in desiccators and weigh.

III. RESULTS AND DISCUSSIONS

The RGR with reference to lignin content in the leaves following the advancement of growth in the leaves normally emergence in accordance with the sequences of plastochron index. Later the lignin content concur with the distribution and administering system of energy available in the plant as energy execute in all developmental bioactivities. In all the tested leaves i.e.(L1 to L8) the lignin accounts from 12th to 18th day in corresponding to decreased rate of RGR and accorded to a pattern. The observed data displayed in Table (1).

Correlation of the relative growth rate (RGR) and lignifications index contemplate a regression deserving data with the equation y = 0.262 – 0.994x, for the crop season zaid of cropping year 2017 where, y is the relative growth rate (RGR) and x is the lignification index. Similarly, justified the correlation with a regression equation, y = 0.255 - 0.965x, for zaid crop season of cropping year 2018 with usual meaning of symbols. The estimated regression equations so established in graphics was presented for further analysis {Figure 1(a) and Figure 1(b)}. With close examination to the regression line for a converging conclusion, it is evident that the biometabolic process of lignifications inversely proportional to the phenotypic characteristics of relative growth rate of the test herbal. The finding elucidate that the relative growth rate (RGR) comes to 0.0015 with corresponding lignifications index of maximum value i.e. 0.258 $mg.g^{-1}$ in cropping year 2017 and in the same trend when RGR approach to 0.002 the lignin scored 0.26 $mg.g^{-1}$ in cropping year 2018. Further, when the RGR increases to 0.036 then the lignigfication index goes to 0.226 in 2017 and RGR of 0.028 struck the lignin 0.234 only in 2018 cropping year. In other words when lignification is of 0.26 $mg.g^{-1}$ then the relative growth rate (RGR) approximately become 0 and the relative growth rate (RGR) becomes approximately zero when the lignifications index goes to 0.26 $mg.g^{-1}$ approximately in regression line of zaid season of cropping year 2017. Similarly in cropping year 2018 the lignification become highest i.e. 0.26 $mg.g^{-1}$ when RGR become approximately 0. In other words the highest lignification is of 0.26 $mg.g^{-1}$ then RGR 0.242 correspond to approximately 0 in the leave and the relative growth rate (RGR) become approximately 0 when the lignification index goes to 0.26 $mg.g^{-1}$ in the regression line of zaid season.

The estimated line of equation of RGR with respect to lignin follow y = 0.262 - 0.994x denoted the RGR value along with corresponding lignin in mg.g^{-1} as 0.063, 0.20; 0.053, 0.21; 0.043, 0.22; 0.033, 0.23; 0.023, 0.240; 0.013, 0.25; 0.26, 0.003 {Figure 1(a)} for zaid season of cropping year 2017. In the same manner in zaid season of cropping year 2018, the determined regression line denoted y=0.24552-0.965x and accomplished the RGR value correspond to lignin in mg.g^{-1} value as 0.062, 0.20; 0.052, 0.21; 0.042, 0.22; 0.033, 0.23; 0.023, 0.24; 0.013, 0.25; 0.0041, 0.26 {Figure 1(b)}. The recuperation obviously blaze that the lignin formation in the plant begins when the relative growth rate decreases and reaching maximum corresponding to maturity of the leaf growth of the plant which normally proportionate to maximum growth in height and approaching to relative growth rate to zero. In acute analysis to deportment of regression line between RGR and lignin in the convergent result indicates the lignin formation ranged from 0.20 mg/g/m^{-2} when the relative growth rate correspond to 0.063 to 0.26 mg.g^{-1} with corresponding RGR of 0.003 in zaid season of 2017 cropping year {Figure 1(a)} whereas lignin formation ranged from 0.20 mg.g^{-1} with RGR 0.062 to 0.26 mg.g^{-1} to corresponding RGR 0.004 in zaid season of 2018 cropping year {Figure 1(b)}. Thus the allocation of resources including disbursement of energy and the rate of growth and development in a plant is of compensate under a principle.

Table(1): Leaf Plastochron Index (LPI), Relative Growth Rate (RGR) and Lignin of *Allium hookeri* for Zaid season of cropping year 2017 and 2018.

Sl.No.	RGR	Lignin	Days	LPI		No. of leaves	Remarks
1	0.0360	0.226	12	0.18 ≤	≤ 1.42	1-2 (T_1)	Upto L8* (2017)
2	0.0210	0.249	15	1.43≤	≤ 2.42	1-2 (T_2 +S_1)	
3	0.0015	0.258	18	2.43 ≤ ..	…	15-13 (S_1 + S_2)	
1	0.0280	0.234	12	0.27 ≤	≤ 1.54	1-2 (T_1)	Upto L8* (2018)
2	0.0180	0.250	15	1.55≤	≤ 2.54	1-2 (T_2 +S_1)	
3	0.0020	0.260	18	2.55	≤ ….	15-13 (S_1 + S_2)	

T_1-Transition1, T_2-Transition2, S_1-Source1, S_2 – Source2,*neglecting out ranges

The observed experimental values of RGR ranges from 0.003 to 0.027 day^{-3} and those of Lignin from 0.253 to 0.0231 mg.g^{-1} in the present test crop of during zaid season for cropping year 2017 similarly in cropping year 2018, the observed values of RGR ranges from 0.004 to 0.062 day^{-3} and those of lignin from 0.260 to 0.200 mg.g^{-1} (Table 1). Thus the present finding depicted the additional mg.g^{-1} of lignin in the leave the RGR value proportionately decreases. In an extensive analysis on the correlation regression, the established equation evince that in the absence of lignifications the RGR acquired 0.262 day^{-3} or 0.087 day^{-3} on average and for each point supplement in the lignification index, the value of RGR decreases by 0.994 day^{-3} or 0.331 day^{-1} on average in zaid season of cropping year 2017, in the same tendency in zaid crop season 2018, the RGR accomplished 0.255 day^{-3} or 0.085 day^{-1} in absence of lignification and for each additional point in lignification index RGR decreases by 0.965 day^{-3} or 0.321 day^{-1}. The present finding purposively corrugate with other works on different plants. In this respect Grime and Hunt (1975) discussed the matter by plotting RGR against crude index of lignifications which put a value on a five point scale. The lowest point 0 on the scale stand in for no allocation to lignifications and the highest point 5 corresponds to allocation of all resources to lignifications. Concomitant to the implication of the equation it is justified that in the absence of lignifications RGR is 1.44 $week^{-1}$ or 0.205day^{-1}on average. In addition to the relationship, for each point increment in the lignifications index, RGR decreases by 0.20 $week^{-1}$ or 0.028 day^{-1}. Further, the regression equation also exhibited that RGR would be 0.4 $week^{-1}$ or 0.057 day^{-1} at point 5 on the index of lignifications. Van Arendonk and Poorter (1994) summarized by investigation on 14 different grass species and drawn to support the prediction by regression analysis. As a result of analysis on the implication of the constructed equation, for each additional gram of lignin plus hemicelluloses in leaves of area 1m^2, the RGR decreases by 0.0225 day^{-1}. In addition they described that their observed values of RGR varied between 0.11 and 0.27 $days^{-1}$ and those of lignin between 1.93 and 8.44 gm^{-1}.

In close analysis on Table (1) the Leaf Plastochron Index (LPI) with correspondence to RGR and lignin describing the beginning of lignification commence with situation where the LPI scored a value equal or greater than (≤) 0.18, with 0.226mgg^{-1} lignin and strengthen to LPI values equal or greater 1.43 to less or equal to 2.42 with 0.242 mg.g^{-1} lignin then to 0.258 mg.g^{-1} lignin that related with LPI value from equal to 2.61 or above, in cropping year 2017 zaid season whereas in zaid season of cropping year 2018, the lignifications of 0.234 mg.g^{-1} lignin coincides with equal or greater than 0.27 LPI to equal or less than 1.54 LPI then the lignin 0.250 mg.g^{-1} concurred to LPI equal or greater than 1.55 to 2.54 and lignin 0.260 mg.g^{-1} correspond to LPI equal or greater than 2.55 to above (Figure 2). Analysis on the present work out exhibited the leaf plastochron index (LPI) legitimately correlate with the lignifications authenticating the energy distribution in the plant body of *Allium hookeri*, a perennial green spicy herbal normally harvested by plucking or removing matured leaves to whole time of the plants life at about 16-18 days old prior to senescence and extended all throughout the year. In due course the knowledge add up the applicability of agroecological farming practices to yield and yield parameters. The detecting result was corroborated with novel convince as leaves contain much less lignin and the lignin biosynthesis extensively contributes to plant growth tissue and organ development, lodging resistance and responses to variety of biotic and abiotic stresses (Liu, et.al. 2018; Peng, et.al. 2014; Barros, et.al 2015).

Moreover in close analysis on of Table (2) and Table (3) revealed the lignin content in the leaves with relation to advances of their growth indicating the leaves usually emerges according to the sequences of plastochron index consequently execute the lignin content following the distribution and allocation system of energy available in the plant from the sources as energy needed in all developmental activities. Leaf plastochron index (LPI), RGR and lignification and their relationship is often related to the energy distribution which receive from the sources. In all the tested leaves (L_1 to L_8) the lignin content accorded from 12th to 18th day at 3 days interval correspond to the rate of growth rate (RGR) and adopted to unique pattern in plant growth. The ecophysiological adaptation in all the growth phases of the crop naturally coincidence with associative meteorological factors for cropping years 2017 and shown in Figure (3) and for the cropping year 2018 in Figure (4). The findings authenticate the resource allocation of lignification in term of energy thorough growth and development of *Allium hookeri* and confirmed the experimental observed results.

Table (2): Leave emergence, Relative Growth Rate (RGR) and corresponding lignin estimation days in the leaves of *Allium hookeri* for Zaid crop season of cropping year 2017.

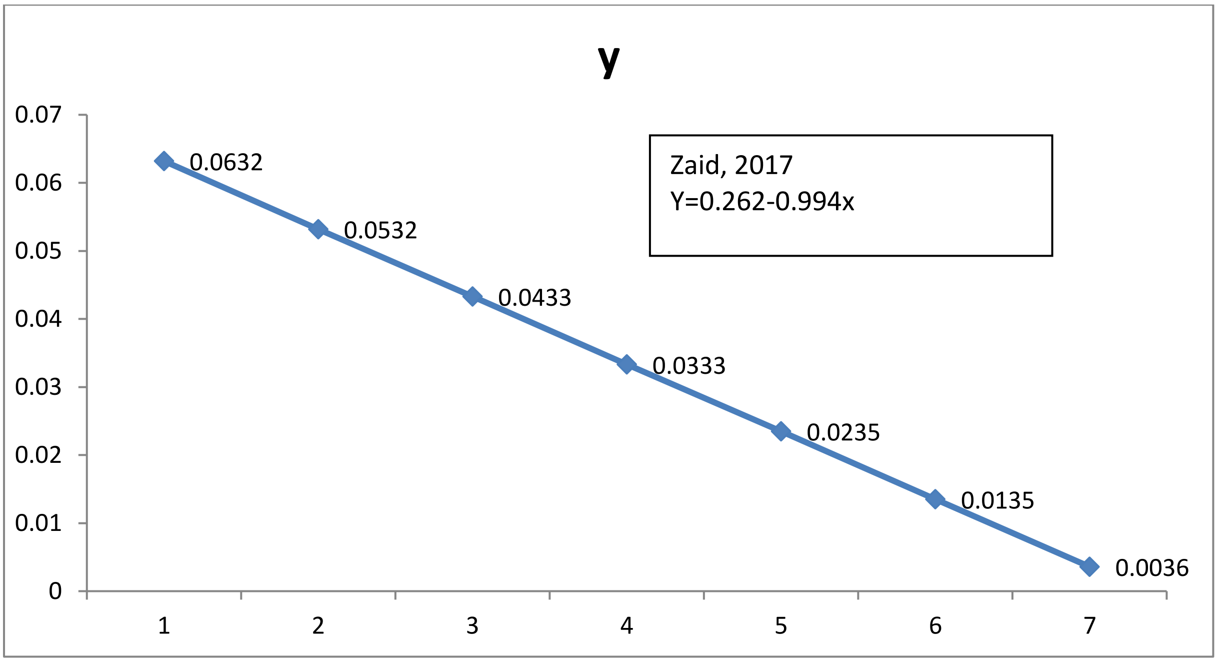
Date	Leaves							
	L1	L2	L3	L4	L5	L6	L7	L8
04/01/17	*							
12/01/17		*						
15/01/17 (12th day for L1)	0.05							
18/01/17 (15th day for L1)	0.031							
20/01/17			*					
21/01/17 (18th day for L1)	0.001							
23/01/17 (12th day for L2)		0.034						
26/01/17 (15th day for L2)		0.013						
28/01/17				*				
29/01/17 (18th day for L2)		0.002						
31/01/17 (12th day for L3)			0.04					
03/02/17 (15th day for L3)			0.022					
04/02/17					*			
06/02/17 (18th day for L3)			0.002					
08/02/17 (12th day for L4)				0.032				
11/02/17 (15th day for L4)				0.02		*		
14/02/17 (18th day for L4)				0.002				
15/02/17 (12th day for L5)					0.03			
18/02/17 (15th day for L5)					0.017		*	
21/02/17 (18th day for L5)					0.001			
22/02/17 (12th day for L6)						0.036		
25/02/17 (15th day for L6)						0.027		*
28/02/17 (18th day for L6)						0.001		
01/03/17(12th day for L7)							0.035	
04/03/17(15th day for L7)							0.023	
07/03/17(18th day for L7)							0.002	
08/03/17(12th day for L8)								0.032

11/03/17(15th day for L8)								0.019
14/03/17(18th day for L8)								0.001

*Days of leaf emergence

Table (3): Leave emergence, Relative Growth Rate (RGR) and corresponding lignin estimation days in the leaves of *Allium hookeri* for Zaid crop season of cropping year 2018.

Date	Leaves							
	L1	L2	L3	L4	L5	L6	L7	L8
02/01/18	*							
10/01/18		*						
13/01/18 (12th day for L1)	0.046							
16/01/18 (15th day for L1)	0.026							
18/01/18			*					
19/01/18 (18th day for L1)	0.003							
21/01/18 (12th day for L2)		0.027						
24/01/18 (15th day for L2)		0.014						
26/01/18				*				
27/01/18 (18th day for L2)		0.001						
29/01/18 (12th day for L3)			0.021					
01/02/18 (15th day for L3)			0.015					
02/02/18					*			
04/02/18 (18th day for L3)			0.003					
06/02/18 (12th day for L4)				0.02				
09/02/18 (15th day for L4)				0.017		*		
12/02/18 (18th day for L4)				0.003				
13/02/18 (12th day for L5)					0.031			
16/02/18 (15th day for L5)					0.019		*	
19/02/18 (18th day for L5)					0.001			
20/02/18 (12th day for L6)						0.033		
23/02/18 (15th day for L6)						0.025		*
26/02/18 (18th day for L6)						0.003		
27/03/18(12th day for L7)							0.022	
02/03/18(15th day for L7)							0.017	
05/03/18(18th day for L7)							0.003	
06/03/18(12th day for L8)								0.026
09/03/18(15th day for L8)								0.013
12/03/18(18th day for L8)								0.001



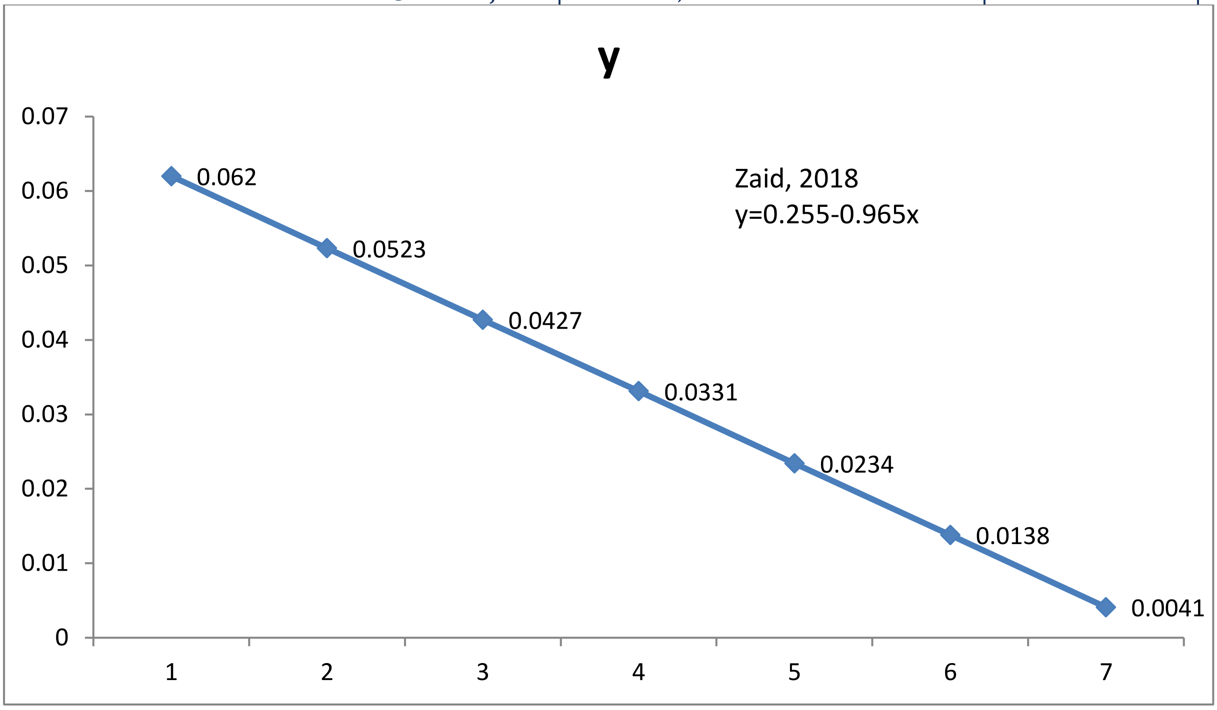
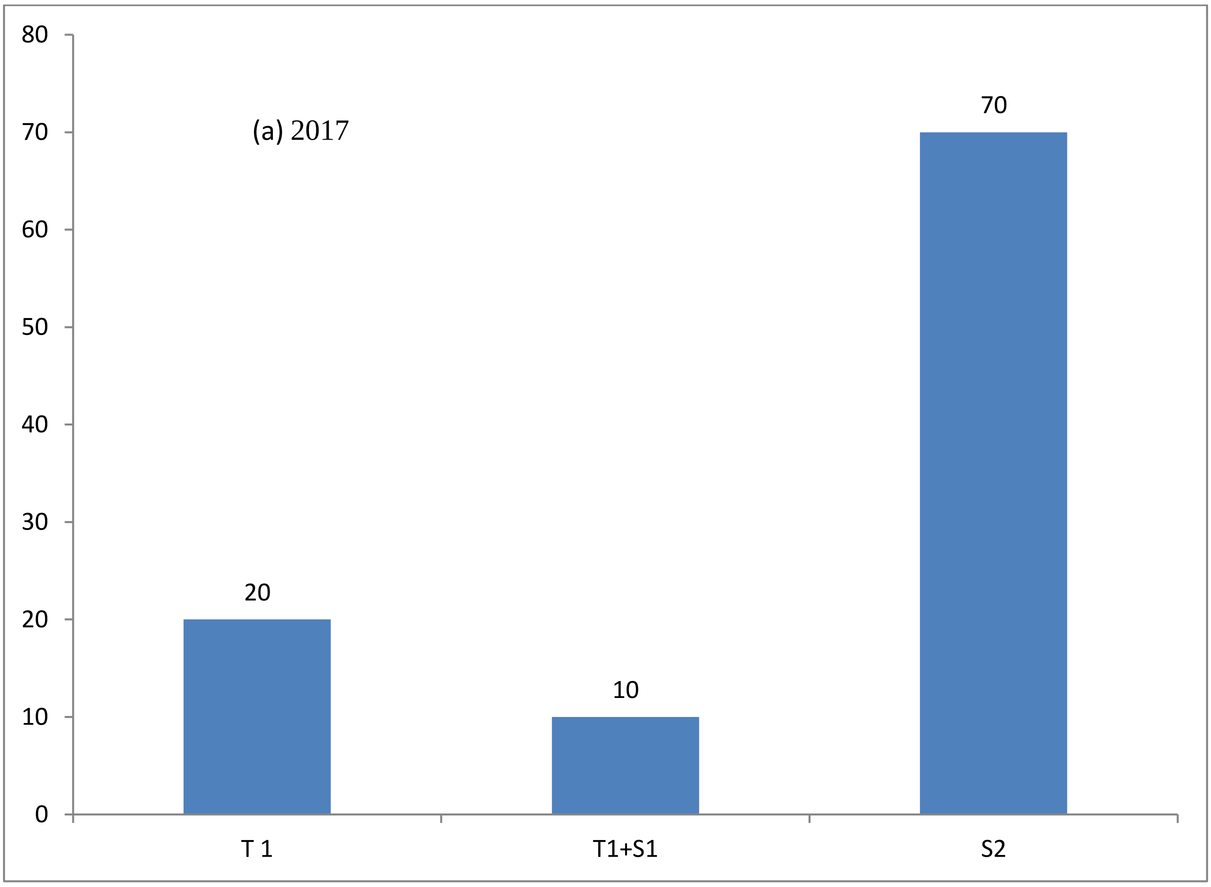


Figure 1. Predicted trade off between RGR and lignification in *Allium hookeri* for the crop season zaid (a) for 2017 and (b) for 2018.



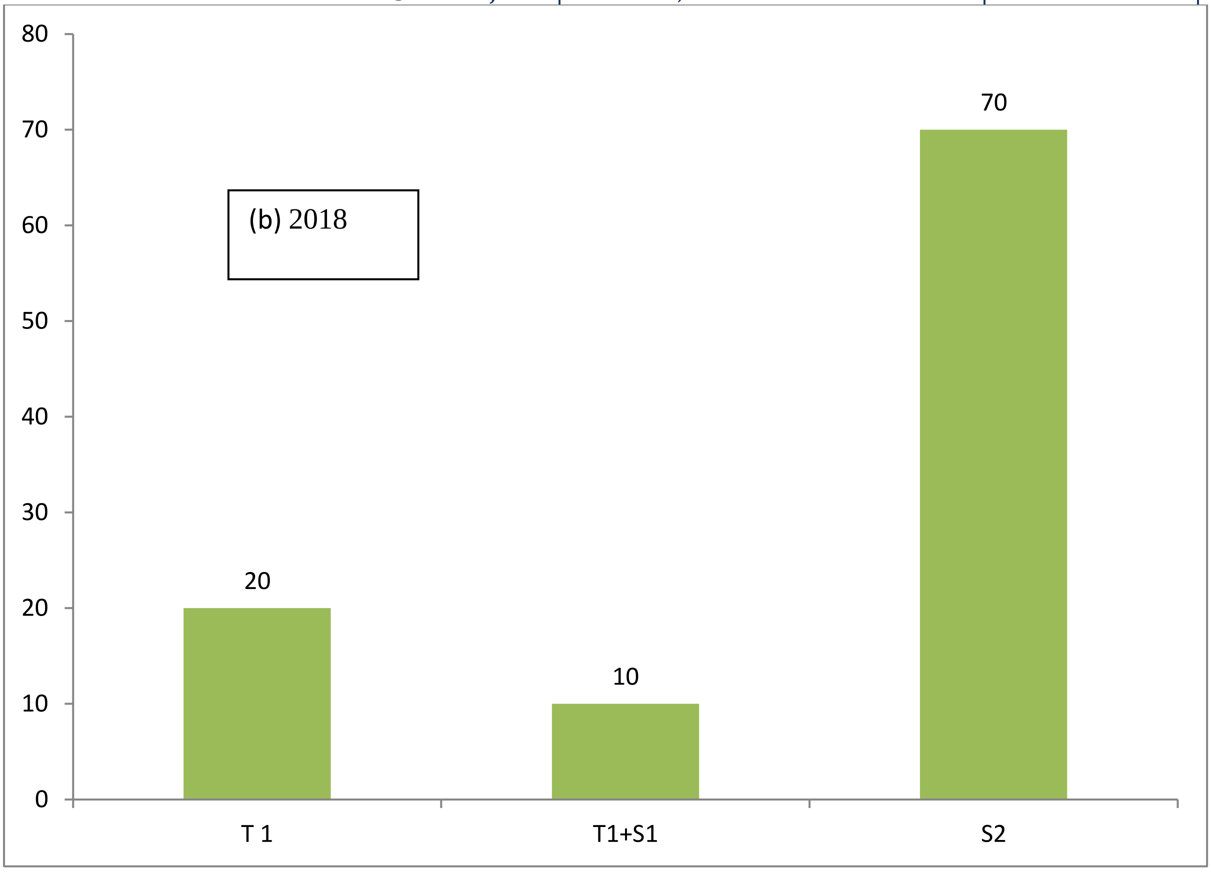


Figure 2. Graphical representation of Transition1 (T_1), Transition2 (T_2), Source1 (S_1) and Source 2 (S_2) ratio for *Allium hookeri* for kharif season of cropping year (a) 2017 and (b) 2018.

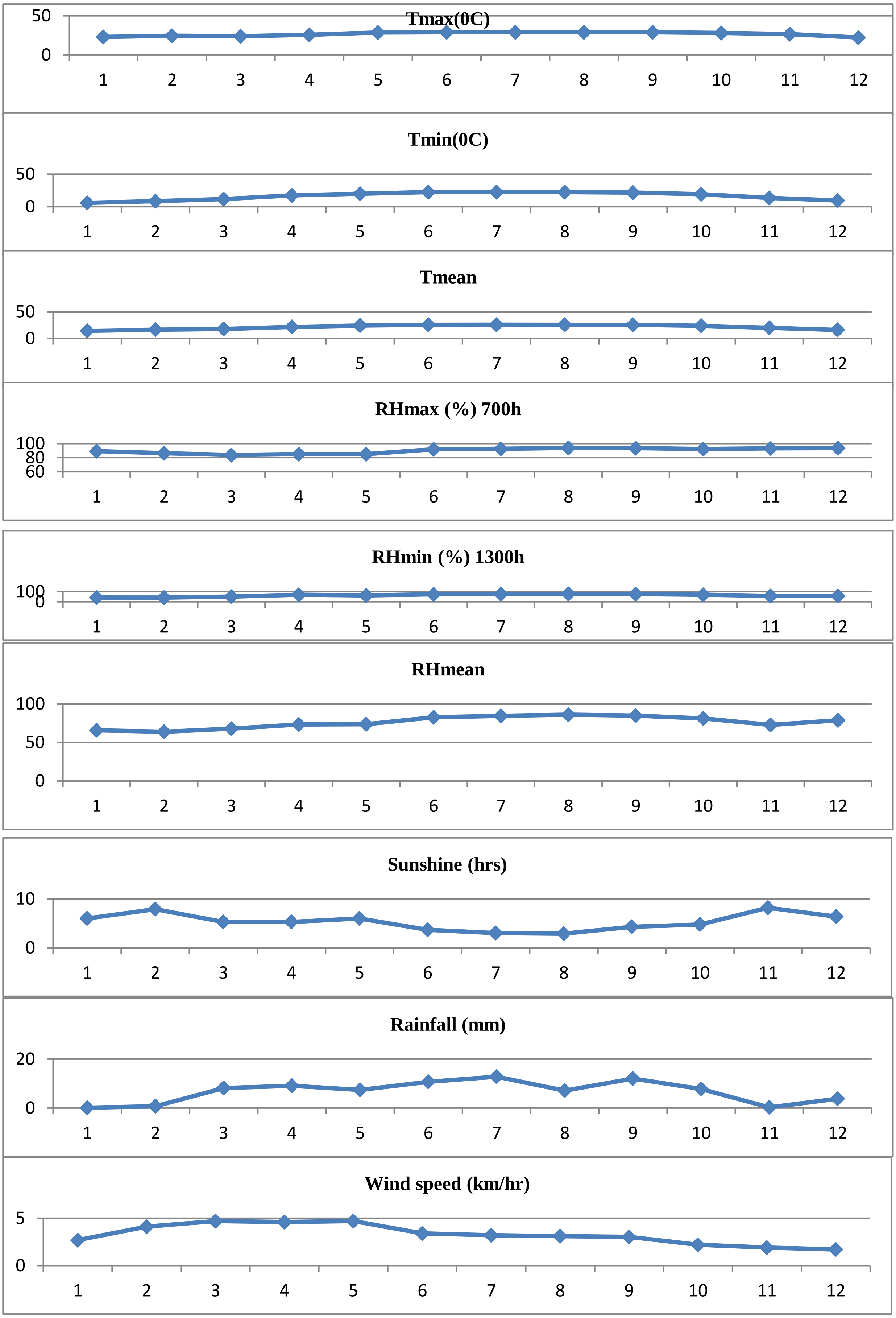


Figure 3: Graphical representation of meteorological data (average), for the year 2017
(Tmax, Tmin, Tmean, RHmax, RHmin, RHmean, Sunshine, Rainfall, Wind speed)

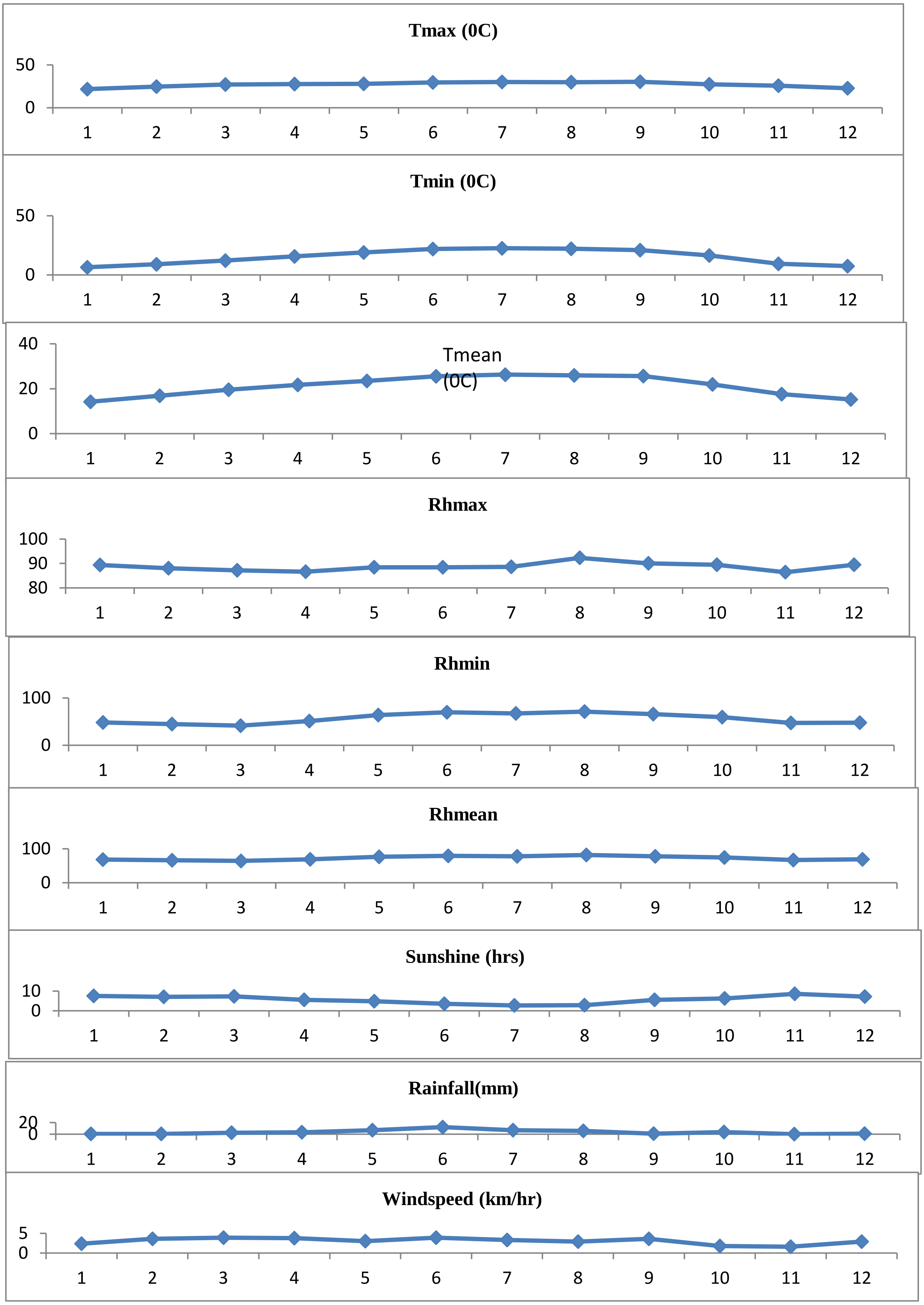


Figure 4: Graphical representation of Meteorological data (average), for the year 2018 (Tmax, Tmin, Tmean, RH max, RHmean, Sunshine, Rainfall, Windspeed).

IV. CONCLUSION

A concrete convergent conclusion comes, the energy allocation in growth of emerging young leaves holds the potential that disburse and allocation of available energy either to leaf growth or to lignifications. The present work out culminate the allocation of lignin with relation to RGR to plastochron index in *Allium hookeri*.

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